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CHEMISTRY

"Stahl's theory of Combustion,
although a great error deserves from
its important results to be ranked with
the grandest discoveries of Chemistry."
"Thenard."

Published by G.&C.&H. Carvill N.York.

DICTIONARY OF CHEMISTRY.

CONTAINING

THE PRINCIPLES

AND

MODERN THEORIES OF THE SCIENCE,

WITH ITS APPLICATION TO

THE ARTS, MANUFACTURES, AND MEDICINE.

For the use of Seminaries of Learning and Private Students.

TRANSLATED FROM

'LE DICTIONNAIRE DE CHIMIE, APPROUVÉ PAR VAUQUELIN.'

INCLUDING THE MOST RECENT DISCOVERIES AND DOCTRINES
OF THE SCIENCE.

WITH ADDITIONS AND NOTES,

BY MRS. ALMIRA H. LINCOLN,

VICE PRINCIPAL OF TROY FEMALE SEMINARY, AUTHOR OF
"FAMILIAR LECTURES ON BOTANY."

NEW YORK:
G. & C. & H. CARVILL,
1830.

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n District of New York, ss.
emembered, That on the twenty-second day of June, A. D. 1830, in the
h year of the Independence of the United States of America, G. & C.
vill, of the said District, have deposited in this office the title of a book,
whereof they claim as proprietors, in the words following, to wit:
nary of Chemistry, containing the principles and modern theories of
e, with its application to the arts, manufactures, and medicine. For
f seminaries of learning and private students. Translated from 'Le
ire de Chimie, approuve par Vauquelin.' Including the most recent
s and doctrines of the science. With additions and notes, by Mrs.
. Lincoln, Vice Principal of Troy Female Seminary, author of 'Fa-
ctures on Botany.'"
ormity to the act of Congress of the United States, entitled "An act for
ragement of learning, by securing the copies of maps, charts, and
the authors and proprietors of such copies, during the times therein
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act for the encouragement of learning, by securing the copies of maps,
d books, to the authors and proprietors of such copies, during the
rein mentioned, and extending the benefits thereof to the arts of de-
ngraving, and etching historical and other prints."
FREDERICK J. BETTS,
Clerk of the Southern District of New York.

Robinson, printers, No. 26 William street.

Copy of a letter of Professor Eaton to Professor Silliman.

To Professor Silliman.

Dear Sir,

The Messrs. Carvill will send for your examination the printed sheets of the Dictionary of Chemistry now in the course of publication. It may be proper that I should tell you how this work came to be translated from the French by Mrs. Lincoln.

Being a teacher of experimental chemistry, according to the course of my little text book, I found that a dictionary would be very important. Ure is too large. It is rather the whole science given alphabetically. I had nearly come to the conclusion to *undertake the labour* of preparing one which should *be intermediate* between an alphabetical exposition of the whole science, and a mere definition of words; and which should be brought down to your "*posting up*" of the science in the system you have just published. At that moment I received a French copy of this work. I examined it with particular care, and used it continually for six months. It appeared to me to be every thing which the pupils of *great* and *small* teachers, like *you* and *myself*, require. As the Troy Female Seminary need a similar work, I prevailed on Mrs. Lincoln to undertake the translation. Being herself a teacher of chemistry, a good French scholar, and having a learned native Frenchman for an assistant teacher, I knew she could execute it better than almost any one. I have now examined the printed translation, and do not hesitate to say it is well translated, and that the mechanical part by Messrs. Carvill is well executed.

Yours, most respectfully,

AMOS EATON,

Senior Professor in the Rensselaer School.

Troy, N. Y., June 12, 1830.

y of a letter from Benjamin Silliman, M. D., Professor of Chemistry, Pharmacy, Mineralogy, and Geology, in Yale College, New Haven, Conn.

Having examined a sufficient number of articles to enable
to form a judgment of the value of the Dictionary of Che-
stry, translated from the French by Mrs. Almira H. Lincoln,
d published by Messrs. G. & C. & H. Carvill, I have no he-
ation in saying that it appears to me to be a learned, judi-
us, and able performance.

have never seen the original, but the translation carries
th it internal marks of accuracy; and I am impressed with
belief, that this Dictionary will answer a very valuable pur-
se both to learners and teachers of the science in this
untry.

B. SILLIMAN.

ale College, June 22, 1830.

TRANSLATOR'S PREFACE.

THE origin of this volume may be learned from the foregoing letters; should it be destined to as favourable a reception as has been given by the public to the "Familiar Lectures on Botany," the translator will consider herself as repaid for months of severe application, in which, relinquishing the pleasures of society, and abridging the hours allotted to repose, she devoted all her leisure to the accomplishment of this object. She hopes to disarm criticism by an humble acknowledgment of imperfections; and solicits from the friends of science correction of any material errors that may be noticed, and indulgence for the inadvertent use of French idioms, or an occasional want of perspicuity. Through care to avoid ambiguity the very fault itself may sometimes have been committed.

The style of a dictionary must at best be dry and sententious; this is not proposed as a reading book, but chiefly for reference, as will be seen by recurring to the introduction of the compilers, which explains the use and importance of a chemical dictionary. The compilers of the original work are MM. Brismontier, Le Coq and Boisduval; these gentlemen, impressed with the importance of such an undertaking, united their labours, selecting from the best French and English authors up to the year 1826, which was the date of their publication: their work having been submitted to the great chemist, Vauquelin, appeared under the sanction of his illustrious name.

The translatior has made additions from Ure, Webster, Green, Journal of Science, Silliman's Chemistry, and some of the latest French writers. The original work, in many cases, has been considerably abridged, particularly in the long processes for the manufacture of gunpowder, glass, saltpetre, &c. The physician may notice a deficiency of some articles connected with animal chemistry, but will readily comprehend the propriety of these omissions.

The *History of Chemistry*, and Sketch of *Elementary Chemistry* are added to supply a deficiency in the books used in schools; these parts are designed to be read by pupils with reference to public examinations. The *History of a Science*, or in other words, of the progress of the human mind in relation to that science, is always interesting, and furnishes hints for future improvement. *General views* of a science enable the student to comprehend the beauty and regularity of the whole as a system; it is indeed necessary in commencing, to proceed by the slow and sure method of learning single facts, and of deducing from these facts, general principles; but in course of time an opposite process becomes necessary; we need to pause in order to examine the ground already passed; and standing as it were upon an eminence, to comprehend under one general view, the facts which establish principles, and the principles which constitute the science.

In this institution, according to the excellent method introduced by Professor Eaton into the Rensselaer School, each pupil in Chemistry, is required to prepare a lecture with suitable experiments for public examination; in addition to this exercise the History of Chemistry, and Sketch of Elementary Chemistry of this volume will furnish proper subjects for a general examination of the class. To some of the teachers and pupils of the Seminary the translator would offer her thanks for their kind assistance in transcribing the following pages for the press.

The publishers and translator consider themselves as fortunate in having secured for the work while in press, the care of Dr. Sidney Doane, of New York, a graduate of Harvard University, who having recently passed two years in Europe, and attended the chemical lectures of the *savans* of Paris, was highly qualified for the trust. While the translator would do justice to Dr. Doane's faithfulness and ability, she would not be understood as laying upon him any responsibility for the correctness of the work, either with respect to facts or style. She would again request indulgence for any occasional errors, and remind the public that these pages have been written amidst the interruptions and duties incident to her connection with this institution. To use the words of an elegant scholar and distinguished chemist, "life is fast flying away, while in the hope of discharging more perfectly our obligations to our fellow-men, we wait in vain for continued seasons of leisure and repose, in which we may refresh and brighten our faculties, and perfect our knowledge. After we are once engaged in the full career of duty, such seasons never come;

our powers and our time are placed inin cessant req
tion; there is no discharge in our warfare; anc
must fight our battles, not in the circumstances an
sition which we would have chosen, but in those fc
upon us by imperious necessity."

Troy Female Seminary, June 17, 1830.

N. B. In the French dictionary, temperature is expr
by degrees of the centigrade therometer, 100 of which
212° of Fahrenheit; in the translation these have been
verted into degrees of Fahrenheit; this is done by mul
ing the centigrade number by 9, dividing the product
and adding 32 to the quotient; for as 5 : 9 : : 100 : 212-

HISTORY OF CHEMISTRY.

The study of nature, as exhibited in the *material* objects which compose the globe, and exist upon or near its surface, is called *Physics*, while the study of the *mental* phenomena, in contradistinction, is called *Metaphysics.*

Physics, or the study of nature, includes Natural Philosophy, which acquaints us with the general properties and mechanical laws of bodies, the physical laws of attraction, light, and electricity; it is founded on observation and experiment, and derives important assistance from mathematical science.

Mathematical Science is founded on intuitive or self-evident truths, and embraces the relations of magnitude and number. On this science depends the measuring of heights and distances, the computation of quantity, the principles of perspective drawing, navigation, surveying, and astronomy.

Astronomy teaches the motions, dimensions, and distances of the heavenly bodies; it is superior to all the other natural sciences, in the vastness and sublimity of its objects; its practical utility is very great in directing the navigator to pursue his way through the trackless ocean. The superstitious fears with which some of the phenomena of nature anciently inspired the ignorant, are dissipated before the light of astronomical science; an eclipse ceases to be viewed as an intimation of the wrath of an offended Deity, when its physical cause is calculated and explained.

NATURAL HISTORY considers the external appearance of natural objects; the term history, which literally signifies a description of actual appearances, not being confined to the same meaning as when applied to the history of nations, or civil history, which signifies a relation of past events.

The divisions of natural history are zoology, botany, and mineralogy.

ZOOLOGY, which includes the whole animal kingdom, from the human species to the smallest animalcules, has many subdivisions; as *ornithology* or the study of birds, *ichthiology* of fishes, *entomology* of insects, *conchology* of shells, &c.

BOTANY investigates the vegetable tribes, including all organic substances not comprehended under the animal kingdom. The oak of the forest, the rose and lily of the garden, the grass of the meadow, the moss that grows upon the rock, and the lichen which appears on decayed wood and the barks of old trees, are subjects of this study. Botany has not unaptly been termed "the poetry of natural history."

MINERALOGY is the science which arranges the *inorganic* substances of the globe, including not only earths, metals, salts, and combustibles, but water and atmospheric air; all material substances on the globe not embraced in the other two departments of natural history, are the objects of this science. Although organic substances are in general more interesting than minerals, yet the latter present to the investigating mind never failing objects of interest and admiration. The subject of crystallization offers many wonderful phenomena; and there seems no less a mysterious agency operating in the atoms of bodies, and leading them all to arrange themselves in their characteristic forms of crystals as cubes, prisms, octagons, &c., than in the wonderful organization of plants and animals.

GEOLOGY, a branch of *mineralogy*, includes a knowledge of *minerals* as they exist in large masses, forming rocks, mountains, &c. It investigates the structure of the globe, the nature of the changes it has undergone, and by the aid of experience prophesies future revolutions. It is an important study when viewed either in relation to the grand objects with which it is conversant, or in its ennobling effect upon the minds of those who pursue its bold investigations.

CHEMISTRY takes a wider range than any other department of physical science; in the mineral kingdom it penetrates the hardest materials, and inquires into the nature of their elementary constituents. In the vegetable substances, chemistry with scrutinizing glance detects their medicinal and nutritious qualities; do these require to be separated from their various combinations? this almost magic art can disentangle and set them free. In the animal kingdom, chemistry performs a high and solemn office, teaching proud man himself, that his own material frame, beautiful in its aspect and noble in its bearing, is in truth but a compound of a few simple elements, which as they have previously existed in other combinations, will again be dissipated to become parts of the worm that "feeds sweetly" upon the decaying body, and the noisome weed or lowly plant that springs from the soil which covers his earthly remains.

The term chemistry is by some supposed to be derived either from the Greek word *kemia*, or the Arabian *chamia*, which signify to burn; and that this science at first signified the examining of substances by fire. By others, the word chemistry is supposed to have been used by the Egyptians in a sense equivalent to the present meaning of the term *natural philosophy*. Science among the Egyptians, was for a long time confined to the wise men, or *magi*, who carefully concealed their knowledge from the people; Plutarch supposes that the study of nature, for this reason, was called chemistry, which word, in his opinion, signified the *secret science*. Whatever might have been the degree of knowledge of nature possessed by the Egyptians, they were probably acquainted with the most important facts on which the science of chemistry is founded.

The Israelites gained from the Egyptians some knowledge of the art of working metals, and of dyeing red, blue, purple, and scarlet. The Phœnicians are supposed to have understood the manufacture of glass, perfumes, and imitations of precious stones. This knowledge was successively communicated to the Carthaginians and Greeks, and by them to the Romans; the two latter people seem however to have possessed but a very limited knowledge of any chemical operations, or any branch of analytical science. Plato seemed sensible of this when he makes an Egyptian priest say to Solon, "*You Greeks will be always children, for you have neither the antiquity of knowledge, nor the knowledge of antiquity.*" The religious belief of the Greeks and Romans may afford some excuse for their ignorance of nature; who among them would have dared to take water from a fountain or a river, and decompose it by fire? they would have considered it as an act of sacrilege against the Naiad, or the protecting divinity of the stream; the grand priest would have exclaimed against the impious wretch, and the people in their indignation would have torn him to pieces.

Although the Egyptians were idolaters, yet less imagination was mingled with their religious belief, and free from many of the superstitions which kept other nations in intellectual bondage, they dared to look into the secrets of nature. Pliny the elder places the Egyptians as first in the knowledge of the sciences. Democritus of Thrace, who flourished 500 B. C., travelled into Chaldea, Persia, and Egypt; in the last country he gained a knowledge of chemistry that appeared to Pliny almost super-human; and yet this classical and venerable land has transmitted to us scarce a vestige of any discoveries! But we cease to be surprised at this, when we reflect that the library of Alexandria, which contained their treasures of knowledge, was successively destroyed by the victorious Romans and Mahometans.

Science, driven from Egypt, Greece, and Rome, in the 4th century took refuge in Arabia, and chemistry appeared under the name of *Alchemy.*

The alchemists imagined that gold existed in all metals, and it was their great object to ascertain the manner in which it might be separated from its combinations and obtained pure; they expected to find some substance which would enable them to perform this great operation; this imaginary substance, which some pretended to have discovered, was called the *philosopher's stone.* Those who studied alchemy pretended to great secrecy, affirming that some heavy calamity would fall upon any one who should reveal the principles of the science; keeping themselves separate from the world, they invented mysterious characters by which the initiated could hold correspondence without danger of discovery.

Among the alchemists, notwithstanding the folly of their pursuit, and the baseness of their deceptions, we find the names of a few distinguished for talents and learning. *Albert the Great,* a German who lived in the 12th century, wrote a work upon alchemy, in which he described the chemical processes then in use. His treatise on metals was written with clearness, and showed a mind familiar with many of the phenomena of nature. His countrymen, astonished at the extent of his knowledge, accused him of magic, and threw him into prison. His pupil, Thomas Aquinius, wrote upon alchemy, and for the first time the word *amalgam* was introduced into chemistry. In his writings astrology and alchemy were united.

In England, cotemporary with Albert the Great, was *Roger Bacon*, the most enlightened and judicious of all the alchemists. In his treatise "*De mirabili potestate Artis et Naturæ*," (the wonderful power of art and nature,) he protested against the foolish belief in magic, charms, and necromancy; he asserted that superstition tyrannized over the human mind through ignorance of natural phenomena. He was acquainted with the *camera obscura*, telescope, and the use of gunpowder. Notwithstanding he carefully concealed his labours, he was accused of magic and imprisoned. *Raymond Lully* treated of the preparation of acids and phosphorus.

About the middle of the 12th century, *Arnold de Villa Nova*, a physician consulted by kings and popes, directed alcohol and the oil of turpentine to be used in medicinal preparations. John and Isaac Holland wrote several treatises on chemistry, with plates representing the apparatus which they used. They made experiments upon human blood, which have aided the most recent discoveries. They invented the art of enamelling and colouring glass and precious stones.

Basil Valentine, a German monk, taught that all substances were composed of salt, sulphur, and mercury; he was the first who applied chemistry to medicine. The most important of his works was called *Currus Triumphalis Antimonii*, (triumphal chariot of antimony;) in this he gave such an account of his experiments with this metal as excited an interest among all the physicians of Europe.

An opinion had long prevailed among the al
that a medicine might be discovered which sho
universal cure or *panacea** for all diseases; some
that this could be found in the philosopher's ston
not only converted metals into gold, but among
traordinary virtues, possessed the power of r
man immortal upon earth.

Of all the alchemists, none appear to have p
to so many discoveries as *Paracelsus*, a native
zerland, born in 1493. He confidently boasted
was in possession of an elixir which would re
immortal; but he died in the prime of life, le
followers overwhelmed with shame and disma
last of the alchemists was *Van Helmont*, who b
being in possession of the universal remedy to
gave the name of *alkahest*.

The alchemistical system crumbling into ru
mistry, like the fabled Phœnix, arose from i
Beccher, a professor of medicine in German
that the earth was not a simple element, but a
tion of elements; he attempted to establish che
its true basis, that of analysis; his experiment
great use to succeeding chemists.

Stahl, the pupil of Beccher, remodelled and
the theory of his predecessors, attempted to ex
process of combustion, and to reduce the phen
chemistry under a certain number of heads. H
of combustion supposed that a certain substan
he called *phlogiston* formed a part of all co

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* This term is derived from two Greek words, signifying to

bodies, and that its separation constituted fire. On account of the boldness of his investigations, he was called the sublime Stahl. He is the first chemist who appeared to have any clear ideas of *chemical affinity*; he even suggested the theory of *double elective attraction*.

At this period many learned men were engaged in chemical pursuits, and the science was enriched by the discoveries of *Boyle*, *Agricola*, *Glauber*, *Kunckel*, *Libavius*, *Bohnius*, *Lemery*, and others.

Boerhaave, an accomplished philosopher and celebrated physician, published a system of chemistry in 1732, which contained a more ample collection of chemical experiments, and more clear and precise directions for repeating them, than any previously offered to the world. He gave an account of vegetable analyses, more simple and scientific than any which had before appeared.

Notwithstanding all these improvements, chemistry was yet in a very imperfect state; some of the absurd notions of the alchemists still remained, and loose and unsatisfactory reasonings, founded on vague analogies, were employed. It was not for a common mind to attempt to remove the shackles of prejudice which ages had been riveting upon the human intellect. At this time appeared Bergmann, a man gifted with a quick and discriminating genius, a moral courage that could look above "the world's dread laugh," and a devoted enthusiasm for the science of chemistry.

With a true analytical method he scrutinized nature, with a view to ascertain her laws of aggregation; he arranged the well known tables of *elective attraction*, and published many important experiments upon volcanic products. The clearness of his conceptions, the accuracy of his observations, and the methodical arrangement which he introduced into the science of chemistry, entitle Bergmann to a rank among its greatest benefactors. A native of the same country, and cotemporary with the great Linnæus, it was his high destiny to labour with almost equal success in the cause of natural science; while Linnæus was investigating the external forms of matter, with a view to the systematic arrangement of the animal, vegetable, and mineral kingdoms, Bergmann was analyzing and arranging the elements of which they are composed. With the frankness and generosity which marks a noble mind, he sent to Linnæus an account of his experiments and observations; the latter, equally generous, forwarded Bergmann's communications to the academy of Stockholm with this inscription, "*Vidi et Obstupui,*" (I have seen and am amazed.)

Scheele, the pupil and friend of Bergmann, enriched chemistry with new and important facts; he died in 1786, two years after the death of his predecessor; his name is commemorated in the name of a compound of copper and arsenic, (arsenite of copper,) called *Scheele's green.* By a late distinguished chemist* he has been called the Newton of chemistry.

Soon after the death of Bergmann and Scheele, a series of splendid discoveries marked the advancement of chemical science in Great Britain. Dr. Black discovered

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* Thomson.

care and research they formed that which is now the almost universal language of the science.

Great Britain may boast of many distinguished modern chemists; of Davy, the powerful advocate of the chloridic theory, and the inventor of the safety lamp; Murray, Brande, and Thomson, with many others, whose labours have enlightened the present age, and whose works will render their names familiar to succeeding generations.

On the continent, Berzelius, Vauquelin, Berthollet, Gay-Lussac, Thenard, Dumas, Dulong, Pelletier, and others, have carried their researches and analyses to a degree of accuracy and clearness hitherto unrivalled.

The year 1829 is memorable for the loss sustained by science, in the death of two of her most distinguished votaries; but long will the halo of glory encircle the venerated names of Vauquelin* and Davy.

In America, Franklin, fearlessly encountering the lightning from heaven, proved its identity with electricity, and taught mankind to guard against this awful agent of destruction. Hare, Silliman,† Eaton, with other veterans in the science, and less experienced chemists, are interrogating nature with a brighter prospect of discovery than that which encouraged the efforts of their predecessors; for as the field of discovery and improvement is infinite, in proportion as facilities for them are multiplied, so are the motives for exertion. As proper would it have been, at the period when earth, air, fire, and water were considered as the four elements of nature, for an investigating mind to have rested in this belief, as for such a mind at this day to suppose that we have arrived at the maximum of human knowledge, or have already learned as much of the properties of matter as its Almighty Creator wills that he should know.

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* It was under the auspices of this great chemist that the original of the Chemical Dictionary was published.

† Perhaps no chemical work has ever been published, which exhibits objects of the science in so clear a light as Professor Silliman's late volume of chemistry; the anxious inquiries for his promised second volume, prove that the work is suitably appreciated by the public.

From the nature of chemical experiments, which in most cases require either firmness of nerve, unshrinking courage, or physical strength, and sometimes all these qualities combined, woman may not aspire to add to the stock of chemical science discoveries of her own; but gifted with the intellectual power to trace the relation of cause and effect, and comprehend the wonderful properties of matter which science reveals, she may dare to raise the curtain which conceals the operations of nature, and entering her laboratory, behold the grand experiments which are there exhibited; nor should it be considered a small privilege that she is permitted to share in the sublime discoveries of science, and to feast on the banquet of knowledge prepared by others.

Is it not more noble for an immortal soul thus to employ itself in learning the second causes by which the Deity operates in the material world, than to waste the precious hours of existence in dreaming over sickly works of fancy? Can the admirers of sublimity and beauty find none in the study of nature; or can the lovers of the marvellous find no wonders in her operations?

There i hemistry poetry to satisfy the most extravagant fancy, and in the sublime truths of the science are mysteries far s rpassing the boldest conceptions of human genius.

INTRODUCTION.

In order to facilitate the study of chemistry, we here, comprised within a small compass, present a complete *history* of the science. It may, at first view, seem impossible that we should, in so small a work, have treated of all the important subjects which have filled so many voluminous treatises on this science; or rather, it may be asked, if this abridgment is not made at the sacrifice of that perspicuity which is necessary to a proper understanding of the subject? It is for our work to answer this; we will, however, say in anticipation, that we do not fear the reproach of having omitted any thing essential; we may even be accused of having, with the modern names, been too particular to bring from comparative oblivion, names employed by ancient chemists. We have endeavoured to exhibit theories in the clearest possible light, and have referred the reader to more extensive works, when the importance of the subject has seemed o demand further investigation than our limi lowed.

We do not however suppose that our Dicti alone will be sufficient to those who would pene the depths of chemical science; no science, nor guage, can be acquired by the aid of a dicti alone; the alphabetical order of such a work i posed to methodical investigation; but a dicti seems indispensable as an appendage to eleme works, facilitating the progress of the pupil, by bling him, at one glance, to see the properties o substance whose history he is studying.

With respect to such persons as do not wish t bour of close and methodical investigation, po scientific dictionaries must be to them a *vade me* to them it is not an object to arrive by degrees t knowledge of a particular substance or combin they wish to see at one view a complete history essential properties. With elementary works thi cannot be obtained; the most methodical, trans reader, who searches for the history of any one stance, to many different parts of the work: sup for instance, a metal treated of; its extraction, its sical and chemical properties, its various combina the preparations of which it makes a part, all circumstances become subjects of different sec and the reader must compass the whole work in to obtain correct and precise ideas of this one substance.

We believe the wants of the public truly justify our labours. We have no fears, in the present enlightened age, when the taste for science seems so extensively diffused through all classes of society, that our efforts will fail of being duly appreciated. The love for science which the present age so peculiarly exhibits, ought to be encouraged. What more noble use can man make of his intelligence, than to apply it to the the knowledge of the objects which surround him? Chemistry may well be considered as pre-eminent among the useful sciences; divested of the errors which, thirty years since, rendered the science so intricate and unsatisfactory, it is now open to the researches of all. Nature, if we may so speak, has no longer her secrets; chemistry has discovered the phenomena which operate in her atoms, calculated their effects, traced their bounds, and insulated their elements. Such are the rapid and wonderful results of chemical experiments, that one half hour's attention may suffice to throw light upon some of the most obscure mysteries of nature.

The language of chemistry, with improvements in the science, has undergone great revolutions; nothing can be more absurd than the names given to different chemical preparations, by ancient authors; sometimes the

ame of the inventor, sometimes the appearance
erties of the product, were taken as distingı
ppellations; the pupil was lost in the mass oí
which rendered no assistance to any systema
rangement of the substances. As soon as ch
was based upon established truths; it seemed
sary to reform its language: after various at
our nomenclature seems at present definitely fi

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* Although when applied to chemistry in France, this remark m
few exceptions, be true, yet we cannot say the same of the nomen
English chemists, some of whom admit, while others reject, that of t
Professor Silliman, in his Elements of Chemistry, gives his approba
French nomenclature, particularly that of the *salts*. In this work, th
tor has generally given both the French and English names of substa

CHEMICAL DICTIONARY.

A.

Absorbent. (From *absorbeo*, to suck up.) Substances are so called by chemists, that have the faculty of withdrawing moisture from the atmosphere.

Absorption. By this term, chemists understand the conversion of a gaseous fluid into a liquid or solid, or being united with some other substance. Thus, if muriatic acid gas be introduced into water, it is absorbed, and liquid muriatic acid is formed; if carbonic acid gas and ammoniacal gas be brought into contact, absorption takes place, and solid carbonate of ammonia is produced by the union of their ponderable bases.

The term *absorption* is also applied to a phenomenon which takes place in distilling, when the distilling vessel begins to cool. The internal pressure, which before was greater than that of the atmosphere, becoming less, forces the liquid into which the tube is immersed back into the retort, often breaking it, and causing a loss of the product of distillation. This inconvenience is remedied by the aid of safety tubes; one kind furnished with a ball is called Welter's tube, this only opposes the ascension of the liquid contained in the first flask; the other kind of tube is straight, and adapted to all the flasks of Woulfe's distilling apparatus; it should be observed, that each of the tubes secures only the [illegible] which it is connected, from the absorption of the liquid contained in that which immediately follows it.

Acetates. (From *acetum*, vinegar.) Combinations of acetic acid with salifiable bases; these salts, like the vegetable salts, are decomposable by fire; they generally give in their decomposition a peculiar product, called *pyro-acetic spirit*, or acid. (See this word.) This product is greater, in proportion as the acid has more affinity for the base, and *vice versa;* thus the acetate of silver affords none, that of copper gives a little, while the acetates of zinc and manganese furnish a great quantity. As this pyro-acetic spirit is always formed at an expense of the quantity of the acetic acid, such acetates should be chosen as are easily decomposed by heat; as for instance copper. The residue of the decomposition is the metal reduced or oxidated according to its affinity for oxygen, and also a certain quantity of carbon. Most of the mineral acids decompose the acetates, none are wholly insoluble in water; the solutions of those which are very soluble, in process of time, are decomposed and give rise to carbonates. According to Berzelius, the quantity of the oxygen of the oxide is to the quantity of acid as 1 to 6·414.

This computation has reference only to the acetates of magnesia, barytes, strontian, cinchonine, and quinine.

Acetate of Alumine. An uncrystallizable salt, employed in dyeing; it is obtained by the decomposition of alum by means of the acetate of lead. The liquor contains the acetate of potash or ammonia; in this state it is used in the arts; according to Gay-Lussac, alum, the sulphates of magnesia, soda, and the nitrates of potash can decompose it; also the chlorides of calcium, of barium, the nitrate of barytes, and the acetate of lead.

Acetate of Ammonia. Not capable of crystallization; it is prepared by saturating with acetic acid, very pure sub-carbonate of ammonia, or liquid ammonia. It differs from what is called in pharmacy, *Spirit of Mindererus;*

the latter is prepared by saturating in distilled vinegar, the sub-carbonate of the oily ammonia which is obtained by the distillation of hartshorn. This volatile super-acetate crystallizes in delicate prisms.

Acetate of Copper. (*Acétate de Cuivre.*) The sub-deutacetate known by the common name of *verdigris*. It is prepared in the south of France, by bringing the husks of grapes, after the expression of their juice, in contact with plates of copper: this must be distinguished from the substance often seen upon old copper and brass, which is a carbonate of copper. The neutral deutacetate, known under the name of *crystals of Venus*, is prepared by dissolving, with the aid of heat, verdigris in vinegar; the compound is left to settle, then carefully decanted, in order to separate the liquid from the sediment; the liquor is then evaporated, and rhomboidal prismatic crystals are deposited upon little sticks placed crossways in the liquid. This acetate may be dissolved in water, and in alcohol; the solution forms a chestnut coloured precipitate with the hydro-ferro-cyanate of potash, and a clear blue with ammonia; the precipitate is redissolved in an excess of the liquid; the solution also forms a dark brown precipitate with sulphuretted hydrogen and the hydro-sulphurets; if a piece of iron is introduced into the solution, it will immediately be coated with metallic copper.

Acetate of Iron. (*Acétate de Fer.*) It exists in three states; the *tritacetate* is the only kind employed in painting; this is acid, red, and uncrystallizable; it is prepared by exposing to the air iron filings mixed with vinegar or the pyro-acetic acid.

Acetate of Lead. (*Acétate de Plomb.*) Sugar of lead. The *neutral acetate* is a white, sugared salt; it crystallizes in elongated, quadrilateral prisms with dihedral summits; it is efflorescent; water which is saturated with it boils at the same temperature as when pure; it contains about fourteen per cent. of the water of crystallization. It was formerly called *salt of Saturn* and *sugar of Saturn*. It is prepared in large quantities in the arts, by combining directly the protoxide of lead with the vinegar of wood. It possesses the singular property of dissolving a definite quantity of the protoxide of lead, and of transforming it into a sub-acetate; it is by this process that the latter salt is prepared.

The *Sub-acetate* is known under the name of extract of Saturn. It is susceptible of crystallization, reddens curcuma paper, and is less soluble than the neutral acetate. All the other neutral salts can decompose this, producing insoluble sub-salts of lead. Almost all animal and vegetable substances also decompose it. These two salts, the acetate and sub-acetate of lead, form a white precipitate with carbonic acid; that formed with the sub-acetate is much more abundant, a black precipitate is formed with the hydro-sulphuretted alkalies, yellow with chromic acid, white with sulphuric acid, muriatic acid, and the carbonate of soda, and yellowish white with the tincture of nutgalls.

ACETATE of LIME. (*Acétate de Chaux.*) Crystallizes easily in elongated prisms; it is prepared by a direct process. It is employed as a re-agent, to detect the presence of oxalic acid; it is obtained in large quantities in the process of purifying the pyroligneous acid.

ACETATE of MERCURY. (*Acétate de Mercure.*) The *protacetate* is the only kind used; it is little soluble in cold water, more so in warm; it crystallizes in little brilliant spangles; it is obtained by double decomposition, by pouring into a neutral solution of the proto-nitrate of mercury, a neutral solution of the acetate of potash; this acetate is employed in pharmacy.

ACETATE of MORPHINE. (*Acétate de Morphine.*) Crystallizes in acicular rays; it is little soluble in water, but sily dissolved by the addition of a small quantity of acetic acid. Exposed to the action of the voltaic pile, the morphine goes to the negative, and the acetic acid to the positive pole; it acts with re-agents much like morphine; it exerts a strong action upon the animal economy.

It is prepared directly by combining morphine with acetic acid, dissolving it in distilled water, and causing the solution to be evaporated by a slow heat.

Acetate of Potash. (*Acétate de Potasse.*) It was known formerly under the name of *terra foliata tartari.* It is a white salt, very deliquescent, crystallizes in little spangles; it is employed in medicine. In order to prepare it, very pure sub-carbonate of potash should be obtained; distilled vinegar should be put into a vessel of wood, earthen, or silver; to the vinegar is then added, by small quantities, the sub-carbonate of potash in solution, until the liquor is but still slightly acid; it is then left to settle, and afterwards filtered, in order to separate the silex, of which the sub-carbonate of potash always deposites a little; after this process, the liquor is evaporated to dryness. The acid should be a little in excess, because a small quantity of it escapes during evaporation. The potash in that case, being predominant, would act upon the vegetable matter of the vinegar, and colour the liquor. It is for this reason that the vinegar should not be poured upon the potash; for the portion of the potash which is not carbonated, would act upon the vegetable matter of the vinegar, and colour the salt; a circumstance which does not take place when the alkali is gradually introduced into the acid. In order to obtain this salt perfectly white, it should be melted in a silver basin; it will in the first stage of the process be black, on account of a little carbon which is formed at the expense of the acetic acid; this substance is employed to rectify alcohol; but for medicinal uses, this mass should be dissolved in distilled water, the solution filtered and tested; (if not found to be neutral, it must be remedied;) it is then slowly evaporated to dryness in a silver basin.

ACETATE OF SODA. (*Acétate de Soude.*) It is prepared like that of potash; it crystallizes easily. Its crystals have some resemblance to those of the sulphate of soda, when the crystallization of the latter has been disturbed; but they are easily distinguished by pouring upon them a little concentrated sulphuric acid. The acetate of soda might easily be confounded with the acetate of potash; the former, however, differs from the latter, in being better crystallized, and unalterable by the air.

The muriate of platina can also be used to distinguish them, and in case of a mixture of these two acetates, they may be separated by alcohol at 104° F. which dissolves the acetate of potash, but has no effect upon the salt at the base of the soda.

ACETITES. See *Acetates*.

ACIDS. These are compounds which, generally, redden blue vegetable colours, have a taste more or less sharp, go to the positive pole of the voltaic pile when they are not decomposed; they all possess the property of combining with metallic oxides, with ammonia and salifiable vegetable bases, of neutralizing them, and giving rise to compounds named *salts*.

All the acids are more or less soluble in water; they are distinguished into *binary* acids, which are the result of the combinations of a simple combustible body with oxygen or hydrogen, and *ternary* which result from the combination of more than two bodies. Each of these divisions has been subdivided into two sections. In the first division are found the *oxacids* or the products of the combination of a simple body with oxygen, and the *hydracids* or products of the combination of a simple body with hydrogen.

The second division is subdivided into vegetable and animal acids. The acids exist in a gaseous, liquid, and solid state; they present characters too various to be included under a general description.

Acid Acetous. See *Acid Acetic.*

Acid Acetic. (*Acide Acétique.*) Of all the vegetable acids, the acetic acid is the most common, the best known, and the most extensively used. Equally produced by nature and by art, it is found in a great number of vegetables and vegetable productions. It is one of the principal products of the acid fermentation. Vinegar is a combination of this acid, with a greater or less quantity of water, a vegetable mucous matter, a small quantity of alcohol and many salts in solution in the water. The vinegar which is made from the fermentation of wine, contains a certain quantity of the *super tartrate* of potash, which may be obtained by evaporation.

Pure acetic acid crystallizes, or rather forms a crystalline mass, at 56° F. Its density is 1·063 at the temperature of 61° F. It is volatile. Mallerat, who has published an interesting work upon this acid, regards it at 1·063 of density, as a compound of 11·92 of water, and 88·08 of real acid. According to Gay-Lussac and Thenard, it is composed of carbon, 50·229, oxygen 2·2, 12·7; hydrogen 5·629; or in volume, of 3 volumes of oxygen, 14 of the vapour of carbon, and 6 of hydrogen. It is usually obtained from the acetate of copper, called crystals of Venus; for this purpose, the salt is put into a stone retort, to which an adopter, and receiver are fitted, to the latter is connected a tube, which is placed under water. A slow heat is applied, and the fire gradually increased. The acetic acid, which is coloured green by a small portion of the acetate remaining in combination, passes into the receiver. Before using, it is distilled anew, but in a glass retort. In the stone retort there remains a brown powder, which appears to be a mixture of metallic copper minutely subdivided with a little carbon, and perhaps a little of the protoxide of copper.

In the arts, acetic acid is also obtained from the acetate of soda; but as this salt is not easily decomposed, its decomposition is assisted by a determinate quantity of sulphuric acid. Acetic acid is also obtained by purifying the pyroligneous or empyreumatic acetic acid, which is procured from the carbonization of wood in close vessels. The oil or liquid tar which swims upon the top, is first separated from the acid product, and the latter is then saturated with lime. An acetate of lime is now obtained; this, by double decomposition with the sulphate of soda, produces an acetate of soda and the sulphate of lime, which is precipitated. The liquor is then evaporated, the residue is a crystalline mass impregnated with tar; this is purified by heating it sufficiently to inflame the tar; the burnt matter is then diluted with water, filtered and crystallized. It is often necessary to repeat the crystallization, in order to obtain crystals sufficiently pure, they are then treated with sulphuric acid. The acetic acid thus obtained, usually contains a considerable portion of acetate of soda. A salt, known by the name of salt of vinegar, is prepared by impregnating crystals of the sulphate of potash with concentrated acetic acid.

ACID AMBERIC. (*Acide Ambréique.*) Pelletier and Caventon discovered this acid in ambergris. It is yellow in the mass, and white when pulverized. It fuses at 212° F. does not yield ammonia in its decomposition, is little soluble in cold water, dissolves more easily in alcohol and ether. The amburate of potash forms a yellow precipitate with the soluble salts of lime, iron, copper, barytes, acetate of lead, nitrate of silver, and the chlorides of mercury and gold.

ACIDE ANTIMONIOUS. See *Oxides of Antimony.*

ACID ARSENIC. (*Acide Arsenique.*) White, solid, uncrystallizable, deliquescent, and of course very soluble.

It is not volatile, reddens deeply the tincture of litmus. Its specific gravity is 3·391. It forms soluble salts with potash, soda, and ammonia. The waters of barytes and lime form in this acid white precipitates of insoluble arseniates; these are, however, soluble in an excess of arsenic acid. It forms with sulphuretted hydrogen, a light yellow precipitate, which is a sulphuret of arsenic; with the nitrate of silver it forms a precipitate of a deep brick red, which is the arseniate of silver. The arsenic acid exercises no action either upon the muriate, or upon the acetate of cobalt, but forms a rose coloured precipitate with the muriate of ammoniacal cobalt; this precipitate is the arseniate of cobalt. To obtain this, it is necessary to make use of a concentrated solution of arsenic acid, and to employ but 4 or 5 drops; if the water is slightly charged with acid, the precipitate will be blue, light violet, or bluish red; the muriate of ammoniacal cobalt, though susceptible of giving in water precipitates of these colours would be decomposed by the great quantity of the liquid contained in the solution; but if too much acid is employed, the precipitate is redissolved as soon as formed. (*Orfila*, *Toxic. générale*, p. 237.)

Arsenic acid is prepared by introducing into a glass retort of sufficient size, 1 part of white arsenic (deutoxide of arsenic) with 2 parts of liquid muriatic acid, and 4 parts of concentrated nitric acid, an adopter and receiver are fitted to the retort, which is gradually heated until the liquid boils. The heat must be continued until a substance is formed of the consistence of sirup; it is then turned into a capsule and evaporated to dryness.

Acid Arsenious. See *Oxide* (*deuto*) *of Arsenic.*

Acid Auric. A term proposed by Pelletier, for the peroxide of gold; its alkaline compounds are termed *aurates*.

Acid Benzoic. (*Acide Benzoique.*) Solid, white, volatile, capable of being crystallized in acicular satin-like prisms, inodorous when pure, soluble in 24 parts of boiling water and 200 parts of cold water, in one part of boiling alcohol and two parts of alcohol at the ordinary temperature, equally soluble in nitric acid, without being decomposed. According to Berzelius, it is composed of carbon 74·71, oxygen 20·02, hydrogen 5·27; or in volume, of carbonic acid gas 5, oxygen 1, hydrogen 4. It exists in balms, some animal substances, the flowers of melilot, vanilla, &c. Art has not yet been able to create it. It is usually obtained from the benzoin.* The benzoin, reduced to powder, is put into an earthen pan, this is covered by another pan, with a small aperture to admit the passage of the gas; a piece of paper is then put around the two pans, at the edges where they meet, and a moderate heat is applied; the acid soon sublimes, and attaches itself to the upper pan. There is a more expeditious method of collecting this acid than the one above described; but it is usually employed to exhaust the residue from the benzoin which has furnished the greater part of its acid by sublimation; this process consists in pulverizing the remainder, and boiling it for some time with milk a little charged with lime. The boiling liquid is decanted, the dregs being washed in order to obtain the remaining acid; muriatic acid is introduced into the liquid, which forms with the lime a soluble muriate, while the acid, little soluble, is precipitated, accompanied by a certain quantity of resin. When the liquor is cold, the sediment, which has a strong odour of vanilla, is dried, and, mixed with a little charcoal, and then sublimed. In order to obtain it free from resin, it must be heated in a glass retort with an equal weight of nitric acid, at 77° until the mass be entirely dry. The resin is then destroyed; and by dissolving the residuum in boiling water, and leaving it to cool, beautiful crystals will be produced;

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* STYRAX *Benzoe*.

Acid Boletic. A substance obtained by Braconnot from the *boletus pseudo-ignarius*. Its crystals are prismatic, and require 180 parts of water at 68°, and 45 of alcohol, for their solution. This reddens blues, and precipitates nitrate of lead and the salts containing the peroxide, but not those of the protoxide of iron. The acid sublimes with little alteration, when heated.

Acid Bombic. (*Acide Bombique.*) An acid obtained from silkworms by M. Chaussier. It is supposed by some to be the same as the acetic acid.

Acid Boracic. (*Acide Borique.*) Solid, colourless, inodorous, fusible above red heat, not volatile, except in certain cases. (See *the super-tartrate of potash.*) It offers acid characters but in a slight degree. It was formerly knownunder the name of *sedative salt of Homberg, or narcotic salt.* Gay-Lussac and Thenard succeeded in decomposing it; and demonstrated that it was a combination of oxygen with a principle which they named boron. According to these chemists, it appears that potassium and sodium are the only bodies which can decompose boracic acid; and this decomposition takes place but at a high temperature. Boracic acid is formed of one atom of boron and two atoms of oxygen :—this gives for the weight of the atom of boracic acid, 24.* It is little soluble in cold water, more so in warm; and when cool, crystallizes in pearly spangles: this appearance, according to Robiquet, is owing to an oily matter which the borate of soda retains. It was with this last substance that the boracic acid was formerly prepared; it is now found in large quantities in the waters of certain lakes. In order to extract the acid from the sub-borate of soda, it is necessary to melt the salt in seven or eight parts of water; into this liquor must be poured the diluted white of an egg; the liquor is then filtered; when partly cool, 750 grammes* of sulphuric acid are by slow degrees added to a kilogramme of the salt. The liquor being cooled, the supernatant liquid is decanted; the acid washed with cold water; the mother waters and the waters of the washing are then united, evaporated, and crystallized; the acid is spread upon paper, and placed in a situation to be dried by a moderate heat. As in this state it retains a little sulphuric acid and a little oily matter, it is necessary, in order to obtain it very pure, to melt it in a crucible, dissolve it in water, crystallize it, redissolve, and preserve it in a bottle closely stopped; it is used in medicine.

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* 1 atom of boron $= 8$; 2 atoms of oxygen $= 16$. $16 + 8 = 24$.

Acid Butyric. (*Acide Butyrique.*) Discovered by Chevreul in butter, which contains a small quantity of it in a free state; it is obtained by treating the butyrate of barytes with sulphuric acid.

This acid is a liquid, nearly colourless, odorous, having at 50° a density of 0·9675. It is not solidified at —15°, does not boil at 212°; it dissolves in water, is easily inflamed upon the approach of a burning substance; it forms with bases neutral salts, in which the quantity of the oxygen of the base is to that of the acid as 1 to 3, and to the acid itself as 10·3 to 100.

Acid Camphoric. (*Acide Camphorique.*) Solid, forms plumose crystals of a bitter taste, little soluble in water, more so in alcohol, volatile oils, and mineral acids; it is always the product of art, being the result of the action of a large proportion of nitric acid upon camphor, requiring 14 parts, at 77° to 1 of camphor.

Acid Capric. (*Acide Caprique.*) Is found in soap made with the butter obtained from cow's milk; it appears in the form of little colourless needles at 62°; it is liquid at 65°; its density is 0·9103; it is very soluble in alcohol, scarcely soluble in water; it unites to salifiable bases, and forms neutral salts, in which the quantity of the oxygen of the oxide is to that of the acid, in the proportion of 5·89 to 100. Its name is given on account of its having a peculiar smell, resembling that of a goat, (*caper.*)

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* A gramme is a French weight of little less than 19 grains; a kilogramme is 1000 grammes.

ACID CAPROIC. (*Acide Caproique.*) Exists in the soap made from the butter of goat's milk; it is in most of its properties similar to the acid above described, except that it is liquid; like that, it combines with salifiable bases; in the salts which result from this combination, the quantity of the oxygen of the oxide is to that of the acid as 7·5 to 100.

ACID CARBAZOTIC. A peculiar acid resulting from the action of nitric acid upon indigo. It appears in yellow crystalline scales, and is dissolved readily by ether and alcohol. It acts like a strong acid upon metallic oxides, and yields crystallizable salts.

ACID CARBO-MURIATIC. (*Chloroxi-Carbonique.*) See *Acid chloro-carbonus.*

ACID CARBONIC. (*Acide Carbonique.*) Known formerly under the names of *calcareous acid*, *carbonaceous acid*, *vitiated air*, *aerial acid*, &c. Carbonic acid is now perfectly well understood; it is one of the constituents of carbonate of lime, which forms immense beds, and chains of mountains; carbonic acid exists in the waters of many springs, and the air of the atmosphere always contains a certain quantity. It is composed of one volume of the gas of carbon, and one of oxygen; in weight 27·67 of carbon, and 72·33 of oxygen; its density is 1·5245, it is of course heavier than atmospheric air. It may be poured from one vessel to another in the same manner as liquids; it collects in low places, wells, cellars, and galleries of mines. It is fatal to animal life. Its presence may be detected by means of a lighted taper which this gas will extinguish. It is a colourless gas, with an odour somewhat sharp; it has been liquified by exposure to cold, and considerable pressure at the same time. It can be combined with water, by means of a condensing pump; water may be charged even with many times its own volume of gas, and by this process, natural mineral waters are imitated. Water containing a very small quantity of this gas, gives a white precipitate with lime water. This precipitate which is the carbonate of lime, may be redissolved by an excess of acid.

This water has a sourish taste, and if submitted to a temperature slightly elevated, throws off in the form of bubbles, all the acid which it contained. Carbonic acid gas extinguishes combustion, and destroys the respiration of animals. According to Gay-Lussac and Thenard, it can be decomposed by potassium and sodium; in the former case with the disengagement of caloric and light; in the latter of caloric only; the metal is oxidated, and the carbon set free. The acid is entirely decomposed when the metal is in excess; if the metal is not in excess, the acid is in part absorbed.

Carbonic acid is procured either by calcining a carbonate, or separating it from its combinations by means of an acid. White marble is generally chosen as being the most pure carbonate of lime; upon this is poured either sulphuric acid, or diluted muriatic acid; the former is preferable because it is not volatile, and of course does not pass off with the disengaged carbonic gas; but it is attended with the disadvantage of forming around the pieces of marble, a crust of sulphate of lime, which diminishes the action of the acid; it is necessary to shake the decomposing mass from time to time, and to wash the gas before collecting it. (Pelletier and Caventon.)

Acid Caseic. (*Acide Caséique.*) It is of a yellow colour, of the consistence of sirup, and of the taste of cheese; it is bitter and sour; nitric acid transforms it into oxalic acid; it gives off ammonia by distillation. Chlorine, lime water, acetate of lead, and muriate of tin, do not act upon it.

Acid Cevadic. (*Acide Cevadique.*) Exists in the form of needles, or crystalline concretions, of a beautiful white, soluble in water, of a colour analogous to that of the butyric acid; it melts at 68° F. and sublimes at a moderate heat, without decomposition. It is soluble in ether and alcohol; and forms with bases, salts which have little odour. The cevadate of ammonia precipitates white the salts of the tritoxide of iron. The cevadic acid is obtained by treating with potash, the oily substance which by ether is separated from the *cevadilla veratrum sabatilla*; a saponaceous mass is formed, which being diluted with water, and precipitated by tartaric acid, furnishes a liquid, in which is found the cevadic acid. This liquid is distilled; the acid passes into the receiver; it is saturated by barytes, the cevadate of barytes is decomposed by phosphoric acid; the pure acid is then obtained by a new distillation.

Acide Chlorous. (*Acide Chloreux.*) See *Chloric Acid.*

Acid Chloric. (*Acide Ghlorique.*) Liquid, colourless, inodorous; it first reddens litmus paper,* and after a few days deprives it of colour, (Vauquelin;) it does not efface the colour of indigo. Dissolved in sulphuric acid at a high temperature, it is decomposed into chlorine and oxygen; it is, even at the ordinary temperature, decomposed by hydrogen, sulphuric, and sulphurous acids. Nitric acid does not produce the same effect, nitrate of silver does not affect it; in weight it is composed of 100 of chlorine, and 111·68 of oxygen; in volume 1 of chlorine, and 2¼ of oxygen. This acid is not found in nature; it is obtained by dissolving the chlorate of barytes in water, and pouring upon it, by degrees, weak sulphuric acid, until the liquor ceases to be affected by the acid, or by the barytes; the liquor is then filtered, and gently evaporated to an oily consistence. Gay-Lussac first succeeded in obtaining it; and to him we are indebted for the investigation of its properties.

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* Paper coloured by matter extracted from the Lichen *parellus*:

Acid Chloric oxygenated. (*Acide Chlorique oxigéné.*) *Hyper-Oxymuriatic Acid.* Without odour or colour; it does not precipitate the nitrate of silver, differs from the chloric acid in reddening the tincture of litmus instead of destroying its colours; it is not decomposed by chloric, sulphurous or hydrosulphuric acids; it unites to bases, and gives rise to peculiar salts. It is composed of 100 of chlorine and 159·79 of oxygen, or in volume of 1 of chlorine and 3½ of oxygen. (*Gay-Lussac, Ann. Chim. et Phys.*) It is extracted by sulphuric acid from the oxigenated chlorate of potash. It was discovered by M. Frederic Stadison.

Acid Chloro-Cyanic. (*Acide Chloro-Cyanique.*) *Chloroprussic Acid.* Known also by the name of *oxygenated Prussic acid;* when pure it is liquid at the ordinary temperature, but when mixed with carbonic acid it is gaseous. In this state it is colourless, of a sharp odour, its density is 2·111; it is soluble in water, the solution is not precipitated either by that of barytes or by the nitrate of silver. It is absorbed by the alkalies; and if an acid is then poured upon the alkalies, an effervesence takes place, carbonic acid is eliminated, and ammonia and muriatic acid are formed.

The chloro-cyanic acid precipitates green the solutions of the protoxide of iron; this precipitate becomes a beautiful blue by the addition of sulphuric acid, a sulphate or a hypo-nitrate; but if potash is mixed with the chloro-cyanic acid, before adding the salt of iron, this precipitate is not formed.

This acid is obtained by passing a current of chlorine through hydro-cyanic acid, (prussic acid,) until this liquid can destroy the colour of sulphate of indigo. It is heated to disengage the excess of chlorine, and agitated with mercury; on being distilled, a mixture of chlorocyanic, and carbonic acid is obtained. This discovery was made by Berthollet, but the properties of the acid were first investigated by Gay-Lussac. This chemist found it composed of 1 volume vapour of carbon, ½ volume of nitrogen, and ½ a volume of chlorine.

ACID CHLORO-PHOSPHOROUS, AND CHLORO-PHOSPHORIC. See *Chlorides of Phosphorus.*

ACID CHLORO-SULPHURIC. (*Chlorure de Soufre.*) See *Chloride of Sulphur.*

ACID CHLORO-CARBONOUS. (*Acide Chloroxi-Carbonique; Carbo-Muriatique.*) This acid is obtained by exposing to the sun a mixture of chlorine, and the oxide gas of carbon, in a very dry state. The mixture will soon lose a part of its volume, and be changed into a colourless gas of a strong odour, which extinguishes combustion, reddens litmus, and has a density of 3·399; this is the chloro-carbonous acid gas; tin, zinc, arsenic, and antimony, absorb the chlorine, and set free the oxide of carbon. Water decomposes it, giving place to carbonic and muriatic acids. Alcohol dissolves twelve times its volume at the ordinary temperature; this gas can absorb four times its volume of ammoniacal gas, and then forms a a deliquescent volatile salt. It was discovered, and first investigated by Mr. John Davy.

ACID CHOLESTERIC. (*Acide Cholesterique.*) Solid, orange yellow when in a mass, in white acicular crystals when derived from spontaneous evaporation of a solution of alcohol. It fuses at 137° ; it does not give off ammonia in its decomposition. Sulphuric acid, charcoal, and nitric acid, dissolve it at all temperatures; it is insoluble in the oil of olives, castor oil, the oil of sweet almonds, and vegetable acids; it is sufficiently soluble in water to redden litmus; it is very soluble in alcohol, ether, and the volatile oils. It is obtained from *cholesterine*, by nitric acid. The discovery of this acid was made by Pelletier and Caventon. (Journal of Pharmacy, vol. III.)

Acid Chromic. (*Acide Chromique.*) Solid, of a purplish red, uncrystallizable when pure, reddening litmus paper very strongly, attracting moisture from the air, and by heat decomposable into an oxide of chrome and oxygen. Sulphuric acid decomposes it, and produces a sulphate of chrome. Its discovery is due to Vauquelin. Berzelius considers it as composed of one atom of chrome, and three of oxygen. It exists in nature in combination in the ruby, and in the chromate of lead, which have as yet been found only in Siberia and Brazil. Chromic acid is extracted from the chromate of barytes dissolved in diluted nitric acid; into this is poured a little weak sulphuric acid; a precipitate of the sulphate of barytes being formed, it is separated by filtering, and the liquor is slowly evaporated to dryness. The nitric acid volatilizes, and the chromic acid remains in the capsule.

Acid Chromo-Sulphuric. (*Acide Chromo-Sulphurique.*) It is obtained from a mixture of sulphuric acid, and chromic acid. Gay-Lussac, who examined this compound, considered it as formed of one atom of chromic acid, and one atom of sulphuric acid. It may be crystallized in quadrangular prisms; it is of a deep red, and deliquescent. Its action upon concentrated alcohol is very remarkable; an explosion takes place, a little ether, and a sweet oil of wine are formed, and the acid is left in the state of a green oxide of chrome.

Acid Chyazic. (*Acide Chyazique.*) A name given by Porrest to the hydrocyanic acid from the initials, c. h. a. carbon, hydrogen, and azote,* which constitute this acid. He gave also the names ferruretted,* argenturetted,† sulphuretted chyazic acid, to the hydro-ferrocyanic acid, and to the combinations of the hydro-cyanic acids with sulphur and silver.

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* French name for nitrogen.

ACID CITRIC. (*Acide Citrique.*) Solid, white, crystallizes in rhomboidal prisms. If exposed in a glass retort to a temperature a little elevated, it will soon be decomposed, and the receiver will be found to contain an empyreumatic oil and pyro-citric acid. It forms a white precipitate with the waters of barytes and strontian, but these precipitates redissolve in an excess of acid. It acts upon the acetate of lead, but not upon the nitrate of mercury or the nitrate of lead. Nitric acid transforms it into oxalic acid. According to Gay-Lussac and Thenard it is composed of carbon 33·811, oxygen, 59·859, and hydrogen 6·330. The results of Berzelius' experiments differ; he states the constituents to be, carbon 41·40, oxygen 54·96, and hydrogen 3·64. This acid exists in a free state in a great number of fruits, but it is usually extracted from the juice of the lemon. For this purpose, the acid contained in the juice is saturated by the subcarbonate of lime; the citrate of lime which is thus formed, is then washed, decomposed by sulphuric acid; the supernatant liquid is treated with charcoal, as in the preparation of tartaric acid. (See this acid.)

The citric acid being an expensive article, it has been found easy to adulterate it by adding a quantity of tartaric acid. This fraud may be easily discovered, by considering that the tartrates with excess of acid are almost wholly insoluble in water. If a solution of potash be poured upon a solution of citric acid, there will be, if the potash is carbonated, an escape of carbonic acid, and the liquor will remain limpid; but if this same alkaline solution be poured upon tartaric acid, the result will be an acid tartrate, which being soluble only in a great quantity of water, is precipitated.

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* From *ferrum*, iron.

† From *argentum*, silver.

Care must be taken that there is not sufficient potash to saturate the tartaric acid, as by an exception to a law common to a great number of salts, the neutral tartrate of potash is more soluble than that which contains an excess of acid.

Acid Columbic. (*Acide Columbique.*) This is one of the acids which contain the least oxygen. According to Berzelius, 100 parts of metal would contain but 5·485 of this acid. It was discovered by Hatchett; it is white, capable of being pulverized, inodorous, insipid, and little soluble in water, still less so in nitric and sulphuric acids; it does not dissolve well except in potash and soda, with which it forms salts. Citric, tartaric, and oxalic acids dissolve it when it is hydrated. It is found in combination, and always in small quantities in nature. It is extracted from its combinations with the oxides of iron, manganese and yttria.

Acid Cyanic. (*Acide Cyanique.*) A name first given by Gay-Lussac and Liebig to the acid which they now call fulminic acid. See ***Fulminic Acid.***

Acid Delphinic. (*Acide Delphinique.*) See ***Phocenic Acid.***

Acid Ellagic. (*Acide Ellagique*, so called by an inversion of the word *galle*, gall.) The discovery of this acid was made by Chevreul. It is in the form of a whitish powder, insipid, almost insoluble in water, alcohol, and ether. Nitric acid decomposes it, colouring it a deep red, and transforming it into oxalic acid. If heated in a retort it gives a carbonaceus residuum, and a yellow vapour, which in condensing produces acicular transparent crystals. It exists in nutgalls with gallic acid. It is obtained by collecting the crystalline deposite which is formed in an infusion of nutgalls, dissolving in boiling water the acid contained in this deposite, bringing the residuum in contact with a weak solution of potash, filtering the liquor, and leaving it to the action of the atmosphere; the carbonic acid of the atmospheric air gradually combines with it and forms a precipitate of ellegate of potash. This is washed, and treated with weak muriatic acid, which combining with the potash sets free the ellegic acid; it is then purified by washing. The ellegates have been little studied. Thenard considers as a neutral ellegate of potash, a soluble salt which greens the sirup of violets, and as an acid ellegate of potash, an insoluble white salt.

Acid Fluo-Boric. (*Acide Fluo-Borique.*) A colourless gas of a strong odour, reddening litmus paper, and strongly attracting humidity from the air. Its specific gravity is 2·371; it is very soluble in water, which can dissolve twice its weight, or 700 times its volume. The water which is saturated by it, is frothy, very caustic, and if heated, loses one fifth of the gas which it contains. Of the metals, potassium and sodium (and these require the aid of heat) can alone decompose it, caloric and light at the same time being disengaged. From this decomposition result boron, and a proto-fluate of potash or soda. It does not act upon glass like fluoric acid. It is obtained by treating with sulphuric acid, a mixture of purified boracic acid, and fluate of lime. The honour of its discovery and the investigation of its properties are due to Gay-Lussac and Thenard.

Acid Fluoric. (*Acide Fluorique.*) So called because it is obtained from fluor spar, or fluate of lime. A colourless liquid of a sharp odour, strongly reddening litmus. It boils at 86° and remains liquid at a cold of 40° below 0. Its action upon potassium and sodium is very powerful, resulting in the disengagement of a large quantity of hydrogen, and a proto-fluate of potash, or soda. It acts, though with less intensity, upon iron, zinc, and manganese.

When mixed with water, the operation must be gradually carried on, since its affinity for this liquid is such, that an explosion will take place, if great quantities of the two substances are at once brought together.

There is in the mixture of water with this acid a very considerable elimination of caloric. This acid combines readily with silex and boracic acid, forming two peculiar acids. (See *Fluo-Boracic* and *Silicated Fluoric Acid.*)

Fluoric acid is, by many chemists, supposed to be a compound of hydrogen and a radical, which they call *plitor* or *fluor*, as the hydro-phtoric, or hydro-fluoric acids; others whose authority is of equal weight regard it as an oxacid; such is the opinion of Gay-Lussac and Thenard, to whom we are indebted for learned researches upon this acid, and who first obtained it apparently pure. It is employed for etching glass; and is obtained by treating the fluate of lime with sulphuric acid.

Acid Fluoric Silicated. (*Acide Fluorique Silicé.*) See *Fluate Acid of Silex.*

Acid Formic. (*Acide Formique.*) From *Formica* an ant. This acid is liquid even below 0, colourless, of a sharp and penetrating odour. Its density is 1·116; this is greater than that of acetic acid. Being mixed at the ordinary temperature with concentrated sulphuric acid, it decomposes into water and an oxide of carbon; and heated moderately with the nitrate of mercury or of silver, it is reduced to water and carbonic acid. According to Berzelius it is composed of 2·86 of hydrogen, 64·67 of oxygen, and 32·47 of carbon. It is obtained from ants, by a complicated process. (For the details of this process, See "Annals of Chemistry and Physics," vol. 20.)

Acid Fulminic. (*Acide Fulminique.*) From *fulminatio*, detonation. This acid is white and pulverulent, little soluble in cold water. It crystallizes on cooling, reddens litmus, and forms with different bases many detonating salts. In order to obtain this acid, the fulminate of silver (fulminating powder of silver) is decomposed by lime; this forms a soluble fulminate of lime, and a precipitate of the oxide of silver. After being filtered, the liquid is concentrated by a moderate heat, and treated with nitric acid; this forms a nitrate of lime, which remains in the liquor, whilst the acid is precipitated. For the knowledge of this new acid we are indebted to Gay-Lussac and Liebeg. It appears from their analyses, to be composed of cyanogen, oxygen, and a little of the oxide of silver.

ACID FUNGIC. (*Acide Fungique.*) From *fungus* a mushroom. Discovered by Braconnot, in mushrooms. It is colourless, uncrystallizable, deliquescent, of a very sharp taste. It forms with ammonia an acid fungate, which crystallizes in hexahedral prisms; and with potash and soda, uncrystallizable salts very soluble in water, but insoluble in alcohol.

ACID GALLIC. (*Acide Gallique.*) Exists chiefly in nutgalls, where it is united to tannin. It is extracted from this substance. Many processes for obtaining it have been proposed; that of Chevreul appears to be the most simple. It consists in putting an infusion of nutgalls, about three quarts, into a flask, and leaving it to remain some time closely corked. It forms a deposite, from which is extracted the fungic acid. (See this word.) In process of time there will form upon the surface a coat of mould; when this coat is sufficiently thick, the flask is exposed to a temperature two or three degrees above zero; a collection of little white crystals is then deposited; these are the gallic acid. These crystals are dissolved in cold water, filtered, the solution is evaporated, and the gallic acid again crystallized. Chevreul recommends to wash the filter with diluted muriatic acid, in order that it may act upon the sub-carbonate of lime and the peroxide of iron, with which the paper is liable to be impregnated.

The gallic acid appears in white brilliant acicular crystals, with an acid taste, soluble in 3 parts of boiling water, equally soluble in alcohol and nitric acid; nitric acid at first renders it purple, then yellow, and at length transforms it into oxalic acid. It forms a greenish precipitate with the waters of lime, barytes, and strontian; it colours all the solutions of the peroxide of iron deep blue, and precipitates the acetate of lead white. It is according to Berzelius in weight composed of 38·36 of oxygen, 56·64 of carbon, and 5 of hydrogen.

Acid Gluic. See *Acid Oleic.*

Acid Hirsic. (*Acide Hircique.*) Liquid at 32°, lighter than water, of the odour of a goat and acetic acid, volatile, soluble in alcohol and little soluble in water, reddens litmus, forms with potash a deliquscent salt, and with ammonia a salt which has a strong smell. It was discovered by Chevreul, while examining the action of the alkalies upon hircina, a substance, which he found with elaine and stearine in the fat of the goat (*hircus,*) and sheep.

Acid Honigstic. A name given to *Mellitic Acid.* (See this word.)

Acid Hydriodic. (*Acide Hydriodique.*) A colourless gas of a strong odour, diffusing white vapours, and extinguishing combustion. Its density is 4·4288. It may be decomposed by oxygen, chlorine, potassium, sodium, and a great number of metals; sometimes the hydrogen is absorbed, and the iodine set free; sometimes the iodine enters into new combinations, and the hydrogen is disengaged.

This acid is very soluble in water. The weak hydracids and the oxacids do not affect it, but nitric and sulphuric acids set the iodine free, by forcing the hydrogen into new combinations. Chloric and iodic acids are affected in the same manner. The hydriodic acid forms with the acetate of lead, a yellow precipitate;

with the deuto-nitrate of mercury, a white precipitate, insoluble in ammonia; this is of course the iodine of silver, since, of the different compounds of this metal, this is the only one which is insoluble.

This acid is easily obtained, by heating in a small retort a phosphuret of iodine, containing 8 parts of iodine and 1 of phosphorus, moistening it slightly, and moderately heating the mixture. The gas is collected in a flask of air; for it dissolves in water, and is decomposed in mercury. It is composed of 100 parts of iodine, and 0·783 of hydrogen; or in volume, half a volume of the vapour of iodine, and half a volume of hydrogen. Gay-Lussac first discovered the nature and properties of this acid.

Acid Hydro-Chloric. *Muriatic Acid Gas.* Colourless, of a sharp odour, extinguishing combustion, having a density of 1·247. It produces white vapours in the atmosphere, by uniting with aqueous particles; potassium and sodium in contact with it are transformed into chlorides, and a quantity of hydrogen is obtained equal in volume to the part of the gas absorbed. (*Gay-Lussac and Thenard.*) It is the same with iron, tin, and manganese. Water dissolves of this acid, about 484 times its volume, at 68°, at the ordinary pressure of the atmosphere. Water, thus charged with gas, throws it off in great quantities by heat. It forms a white precipitate with the nitrate of silver and solutions of lead; the precipitate which is obtained in the latter, is soluble in 50 parts of distilled water, while that of the former is absolutely insoluble. It precipitates white with albumen, but does not act upon gelatine.

This acid forms, with almost all bases, combinations which are regarded as *chlorides* (muriates) or *hydro-chlorides.* (See these words.) It is seldom found free in nature, but forms many combinations. It is for commerce obtained from the chloride of sodium (common salt, or muriate of soda,) by the aid of sulphuric acid. This decomposition is carried on in manufactories in cast iron cylinders; into these is introduced common salt, diluted sulphuric acid is then poured upon it; the gas is received in casks of water, the last of which contains lime-water to absorb the gas which is not dissolved. The muriatic acid in a liquid state is the product of this operation. It may be obtained in small quantities by a similar process, by using a matrass and fitting to it flasks of Woulfe's apparatus. The first flask serves only to wash the gas, which always carries with it a small quantity of sulphuric acid. To obtain the acid very pure, it is necessary to distil it a second time; and the better to disengage the gas, in order to separate it anew, to put into the vessel which is used for the operation some grains of zinc or tin. It was long supposed that this acid was a compound of oxygen and an unknown base, but the brilliant experiments of Gay-Lussac and Thenard have demonstrated that powerful acids may exist, of which oxygen forms no part. This is composed of chlorine and hydrogen; one volume of each of these gases combined, forms two volumes of the hydrochloric acid.

ACID HYDRO-CHLORO-NITRIC. *Nitro-Muriatic.* This mixture of hydro-chloric and nitric acids was formerly called *aqua regia.* These two acids mutually decompose each other, and the result is water, chlorine, and nitrous acid. This acid is one of the most powerful solvents in chemistry; few bodies resisting its action. Among the metals are a few exceptions, as chrome, titanium, columbium, rhodium, iridium, and silver, the last is however attacked by it, and changed into an insoluble chloride. This acid is frequently employed in the arts, and in chemistry. It is always coloured by the nitrous acid which it contains.

ACID HYDRO-CYANIC. *Prussic Acid.* Liquid, colourless, of an acid and corroding taste, its density at 45° is 0·70583, and that of its vapour is 0·9476. It reddens *litmus paper* but feebly, its odour is strong, and it is very volatile; it boils at 79°. The Voltaic pile decomposes it, the hydrogen is carried to the negative pole, and the cyanogen to the positive pole.

When a few drops of this acid are suffered to fall upon paper, the portion which vaporizes, produces sufficient cold to crystallize the remainder. It is soluble in water and alcohol, is easily inflamed by the approach of a burning substance. Sulphur volatilized in the vapour of this acid, gives rise to a solid compound formed of cyanogen and sulphuretted hydrogen. Chlorine disengages its hydrogen, forming chloro-cyanic acid. Potassium and sodium set the hydrogen free, and form cyanides.

Hydro-cyanic acid precipitates the nitrate of silver white. United to potash and to the oxide of iron, it furnishes a double salt of a lemon colour, which is soluble in water; in this solution, a blue precipitate is formed with the salts of iron in the second and third degree of oxidation, a brownish crimson precipitate is formed with the maximum salts of copper, a blood red precipitate with the salts of uranium, and an apple green with those of nickel. (Orfila.)

According to Berzelius and Dulong, prussic or hydrocyanic acid is in weight formed of 3·645 of hydrogen, 44·65 of carbon, and 51·705 of nitrogen, or in volume of 1 of vapour of carbon, ½ of hydrogen, and ½ of nitrogen. Scheele discovered this acid, but Gay-Lussac first obtained it in a state of purity, and investigated most of its properties. The following is the process which that learned chemist has proposed for obtaining it pure.

To a tubulated retort is fitted an adopter containing one half pounded limestone, and one half chloride muriate of calcium. From the adopter proceeds a tube which is placed under a bell-glass surrounded with a freezing mixture. Into the retort should previously have been put cyanide of mercury; through the tubulature is poured a quantity of muriatic acid so that it may be in excess of the cyanide. A moderate heat in then applied, in order that the acid slowly evolving, may disengage itself from the muriatic acid and the water which it contains, while passing successively through the carbonate of lime and the muriate of calcium contained in the cylinder; the prussic acid is condensed in the receiver.

Vauquelin has proposed another process for obtaining this acid. Take three bottles of Woulfe's apparatus; in the first put a sulphuret of iron, and an S tube in order to introduce the sulphuric acid. In the second bottle is put water to wash the sulphuretted hydrogen which is disengaged, and the third is three fourths filled with a solution of 1 part cyanide of mercury in 8 parts distilled water. The apparatus is terminated by a tube for the escape of the evolving gas. In the first bottle is then poured diluted sulphuric acid. The water is decomposed; an oxide of iron, then a sulphate of iron is formed; the hydro-sulphuric acid unites with the solution of the cyanide, forming the hydro-cyanic acid and the sulphate of mercury. When the sulphuretted hydrogen is in excess, the liquid is filtered in order to separate from it the black sulphuret of mercury. A solution of hydro-cyanic and sulphuretted hydrogen is obtained. To this solution is then added the carbonate of lead, which decomposes the sulphuretted hydrogen; after some days the solution is filtered and hydro-cyanic acid obtained at 0·900 of density. As this acts with extreme violence upon animal matter, all possible precaution should be used in its preparation and use.

Acid Hydro-Ferro-Cyanic. *Ferro-Prussic Acid.* According to the researches of Gay-Lussac, Robiquet, and Porrett, it appears that iron and cyanogen can combine in the proportions of 1 atom of iron and 3 atoms of cyanogen, so as to form a new body which shall be the radical of this acid. The opinion of these chemists acquires still more weight, if we consider that sulphur and silver can replace the iron in this compound, and form with hydrogen, acids which Porrett has designated under the names of ferruretted argenturetted, and sulphuretted chyazic acids. (Those who wish to examine this subject are referred to the reports of these chemists.) This acid is in little white crystals which become bluish when exposed to the air; they are soluble in water and in alcohol, communicating to these liquids no colour, but an acid taste unlike that of the common hydro-cyanic, or prussic acid. The aqueous solution poured upon the tritoxide of iron produces the *prussian blue,* which is a hydro-ferro-cyanate (prussiate) of the peroxide of iron.

Acid Hydro-Muriatic. See *Hydro-chloric acid.*

Acid Hydro-Selenic. A colourless gas of an odour similar to that of sulphuretted hydrogen; its action upon the animal economy is most deleterious: it is soluble in water, reddens litmus, and stains the skin brown. It is obtained by treating the selenite of iron, (spongy gypsum,) with liquid muriatic acid. It was discovered and examined by Berzelius.

Acid Hydro-Sulphuric. *Sulphuretted Hydrogen.* Is a gas of a very disagreeable odour; it is without colour, and burns in the atmosphere with a bluish flame. Its specific gravity is 1·1912, it reddens litmus but feebly, is decomposed by a great number of simple bodies; chlorine at the ordinary temperature precipitates its sulphur, iodine acts upon it in the same manner, especially if it be in a humid state. Most of the metals absorb the sulphur and set the hydrogen free. When heated in contact with potassium and sodium, it forms a compound which results from the combinations of the metal with the sulphur and a certain quantity of sulphuretted hydrogen, a portion of the hydrogen being set free. (*Gay-Lussac and Thenard, Researches Physico-Chemical.*)

Many acids decompose sulphuretted hydrogen at the ordinary temperature ; this is always done by abstracting the hydrogen. Among the acids that have this effect, are the chloric, nitric, nitrous, sulphurous, and sulphuric. Water dissolves about three times its volume at 52.° and at the ordinary pressure. In this state it precipitates the solution of the deutoxide of arsenic yellow, and the solutions of lead, copper, and bismuth, black. The gas which the solution contains is eliminated by heat: this gas contains a volume of hydrogen equal to its own; it is composed in weight of 100 of sulphur, and of 6·13 of hydrogen. It is prepared by treating at a moderate heat the sulphuret of iron with diluted sulphuric acid, or the sulphuret of antimony with muriatic acid. It is necessary, while preparing it, to avoid respiration as much as possible, for its properties are in a high degree poisonous, as is the case with almost all the binary combinations of hydrogen.

Acid Hydro-Xanthic. A name proposed by Zeise, to designate the combination of hydrogen with sulphur and carbon, which combination he considered as a peculiar acid.

Acid Hypo-Nitrous. (*Hypo-Nitreux.*) *Per-nitrous.* Gay-Lussac named thus, an acid composed of 100 of nitrogen and 150 of oxygen ; it has never yet been insulated, for it is destroyed in the attempt to separate it from the potash, the only base with which it has yet been combined.

Acid Hypo-Phosphorous. (*Hypo-phosphoreux.*) Liquid, uncrystallizable, very sapid, is easily decomposed by heat. If the operation is carried on in a retort, phosphuretted hydrogen, from the phosphorous and the phosphoric acid, is obtained. It is very soluble in water, and communicates this property to all the salts which it forms. According to Dulong, the discoverer of this acid, it is composed of 100 of phosphorus and 37·44 of oxygen.

It is obtained by dissolving the phosphuret of barium in water; the result is a soluble hypo-phosphite of barytes, the base of which is precipitated by a suitable quantity of sulphuric acid. The liquor must then be filtered and concentrated by a careful evaporation.

ACID HYPO-PHOSPHORIC. (*Hypo-Phosphorique.*) Liquid, viscous, very sapid, having a slight odour of phosphorus, decomposing by heat and transforming itself into phosphoric acid and phosphuretted hydrogen, which inflames at the mouth of the vessel which contains it. It decomposes rapidly in contact with any salifiable base, becoming phosphorous and phosphoric acid; from this circumstance Dulong has inferred that it is but a combination of the two acids. It is obtained by slowly burning sticks of phosphorus in the damp air. According to Thenard, this acid is formed of 100 of phosphorus and 110·39 of oxygen.

ACID HYPO-SULPHUROUS. (*Hypo-Sulphureux.*) Composed of 100 of sulphur and 50 of oxygen.

ACID HYPO-SULPHURIC. (*Hypo-Sulphurique.*) Composed of 100 of sulphur and 135 of oxygen. Its discovery, and the study of its properties are due to Gay-Lussac and Welter. It is a colourless liquid, always retaining a certain quantity of water. When it contains the least possible quantity, its density is 1·347, and then it has commenced a decomposition into sulphurous and sulphuric acids. It easily combines with salifiable bases. It is obtained by passing a current of sulphurous acid gas into water, which holds in suspension the peroxide of manganese. Exposed to cold it produces a neutral compound of hypo-sulphate and sulphate of manganese. This solution is treated with powdered barytes; it is heated, then filtered; a current of carbonic acid gas is then passed into it; after having been boiled it is again filtered. The hypo-sulphate is crystallized, re-dissolved, and the barytes precipitated by a careful addition of sulphuric acid. The acid is concentrated under the receiver of the pneumatic cistern.

Acid Igazuric. (*Igazurique.*) This acid appears under the form of little white needles, very light, very acid, and soluble in water and alcohol. The igazurate of ammonia forms with the sulphate of copper, a fine green colour, and gives place to a granular and crystalline precipitate. The knowledge of this acid is due to Pelletier and Caventon. It exists in St. Ignatius' bean,* the vomica nut,† and probably in the other species of the genus *Strychnos*.

Acid Iodous. (*Iodeux.*) Liquid, of an amber yellow, an oily consistence, of an odour similar to that of the oxide of chlorine; it reddens litmus, volatilizes at 122°, is soluble in water and alcohol. Sulphuric acid decomposes it, and precipitates the iodine. It is obtained by triturating a mixture of iodine and chlorate of potash, introducing the mixture into a retort, and heating it with a spirit lamp. The iodous acid is disengaged in the form of yellow vapours, which are condensed in the receiver; oxygen is also eliminated, and a small quantity of iodine is volatilized.

This acid was discovered and studied by Sementini.

Acid Iodic. (*Iodique.*) Solid, inodorous, white, translucid; changes blue vegetable colours to red, and then destroys all colour. Its density exceeds that of sulphuric acid. At a high temperature it is changed into iodine and oxygen gas. Most of the strong acids decompose it, except the sulphuric and phosphoric, which appear to form combinations with it; it detonates if heated with sulphur or carbon. This acid is formed of 100 of iodine and 31·927 of oxygen. The weight of an atom is 20·625. It is obtained by treating iodine with the protoxide of chlorine. It was discovered by Gay-Lussac.

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* Strychnos *Ignatia.*

† Strychnos *Nux vomica.*

Acid Iodo-Sulphuric. The name of a crystalline compound, of a pale yellow, which is obtained by pouring sulphuric acid, drop by drop, into a hot and concentrated solution of iodic acid. These little crystals appear to contain water; brought in contact with potash or soda, they form an iodate and a sulphate. Nitric and phosphoric acids form with the iodic acid analogous compounds.

Acid Iatrophic. (*Iatrophique.*) A name given by Pelletier and Caventon to a liquid acid, colourless, of a very strong odour, very soluble in water, which they have found in the oil of the jatropha plant.

Acid Karabic. This is the Succinic acid. (See this word.)

Acid Kinic. (*Kinique.*) White, solid, crystalline, very acid, strongly reddens litmus, has not a bitter taste; heat decomposes it, and produces pyro-kinic acid equally crystallizable. The kinic acid has been found only in the quinquina, united to lime and perhaps also a little quinine and cinchonine. It is extracted from the kinate of lime by precipitating the base with oxalic acid. It was discovered by Vauquelin.

Acid Kinovic. (*Kinovique.*) A name given by Pelletier and Caventon to an acid which they found in the heart of the *kina nova*, a tree which grows in Africa. It in some respects resembles the oily acids; it is white, light, flosculous, scarcely soluble in water, but very soluble in ether and alcohol.

Acid Krameric. (*Kramerique.*) Peschier discovered this acid in the root of the ratania. After many attempts, he at length obtained it crystallized under the form of elongated prisms, of a very styptic taste. This acid is peculiar in having so great an affinity for barytes as to take it from sulphuric acid.

Acid Laccic. This has been discovered in stick lac; it is solid, crystalline, of a clear wine yellow, of an acid taste, soluble in water, alcohol, and ether. It precipitates solutions of lead and mercury white; but it acts neither upon lime, water, nor upon the nitrates of silver and barytes. Alone, or in combination, it gives a white precipitate with the salts of the peroxides of iron.

Acid Lactic. Its existence is still uncertain. It may be but the acetic acid united to a vegetable matter, or perhaps the same as the zumic acid. Scheele discovered it in sour whey; according to Berzelius, it exists also in blood. It is a thick liquid, uncrystallizable, soluble in water and alcohol, combining with bases, and forming in most cases soluble salts. It is usually obtained from whey.

Acid Lampic. A name given to the product which is formed during the contact of inflamed platina with the vapour of ether; it appears to be composed of acetic acid, and a compound of hydrogen and carbon.

Acid Locustic. (From *locusta*, in French *sauterelle.*) An acid said to be found in the locust, but not sufficiently known to be distinguished from acetic acid.

Acid Malic. (From *Malus*, a genus of plants which contains the apple.) Liquid, colourless, crystallizable, of a very acid taste; is decomposed by heat, and among other products gives a peculiar acid, called pyro-malic. Nitric acid changes it to oxalic acid. It does not act upon the nitrates of lead and silver. According to Vauquelin, it is in weight composed of 28·3 of carbon, 54·9 of oxygen, and 16·8 of hydrogen. It is the same acid which is sometimes known under the name of *sorbic* acid. It exists in the berries of the sorbus, (mountain ash,) in apples, gooseberries, and the greater part of acid fruit, and the leaves of the *semper vivum tectorum* (house leek.) From the last named plant it is extracted by the following process: The juice of the house leek is saturated by an excess of lime-water, about three quarters of the liquor separated from the excess of lime is then evaporated; this deposites, during the evaporation, the sub-malate of lime, mixed with a colouring matter; the mother water is then separated, the sediment is several times washed with alcohol at about 54°, in order to divest it of the principal part of the colouring matter; it is then treated with water, which dissolves and changes the sub-malate into a soluble malate and lime, the latter remaining combined with a portion of colouring matter.

The solution of the colourless malate of lime is treated by the neutral nitrate of lead; it forms a precipitate of the neutral malate of lead, which, being washed and treated by sulphuretted hydrogen, gives a colourless solution of malic acid. By evaporating this solution, a liquor of the consistence of sirup is obtained; this, on standing a few days, deposites small whitish crystals.

Acid Manganesic. The peroxide of manganese when fused with potassa, absorbs oxygen from the air and becomes manganesic acid. This was discovered by Chevillot and Edwards. Dr. Forchhammer has obtained it by the action of diluted sulphuric acid upon the manganesite of barytes; the *manganeseous* acid, when liberated resolves itself into the deutoxide of manganese and manganesic acid.

Acid Margaritic. (From *Margarita, a pearl.*) White, insipid, inodorous, fusible at 140°, insoluble in water, very soluble in alcohol and ether. Most of the salts which it forms bave a pearly appearance. It reddens the tincture of litmus, and with heat decomposes the sub-carbonates of potash and soda. It exists in the fat of dead bodies. It is obtained by treating pork grease or human grease with potash. According to Chevreul, this acid is a hydrate, containing 3·52 of water, with 100 of dry acid; and in a dry state it is formed of 8·937 of oxygen, 79·053 of carbon, and 12·010 of hydrogen.

Acid Marine. *Hydro Chloric* or *Muriatic Acid.*

Acid Marine Dephlogistic. See *Chlorine.*

Acid Meconic. (So called from *Mekon*, the Greek name of poppy.) Solid, white, crystallizes, sometimes with well defined crystals; it melts and sublimes at 267°, is easily dissolved in water and alcohol. This solution reddens litmus, and with the salts of iron possesses the peculiar property of changing its colour to a fine red, without producing any precipitate; it acts upon the solution of corrosive sublimate, and produces in the solution of the sulphate of copper, a deposite of pale yellow powder. It combines with alkalies, and produces soluble salts. This acid was discovered in opium by Sertuerner, and we are indebted to Robiquet for the best method of preparing it. For this purpose an infusion of opium should be boiled with a certain quantity of magnesia, and the deposite which is formed, collected; this is the sub-meconate of magnesia; it is washed and first treated with diluted alcohol, then with concentrated alcohol; but the sub-meconate can never be entirely deprived of its colouring matter. Diluted sulphuric acid is then poured upon the sub-meconate, it is heated, and a solution of the muriate of barytes is added. A precipitate of meconate and of sulphate of barytes is formed. The precipitate is washed, and then with heat acted upon by weak sulphuric acid, which decomposes the meconate of barytes. This decomposition is less prompt than it would be but for a colouring matter that hinders the action of the acid. The residue is filtered and washed in a great quantity of water; the liquors are united and submitted to evaporation. The meconic acid separates; it is then washed in a little cold water, dried, and sublimed with a gentle heat.

Acid Mellitic. Solid, may be crystallized in little prisms or needles, of a sharp and bitter taste, soluble in water. It forms in the waters of lime, barytes, and strontian, white precipitates soluble in nitric and hydrochloric acids. It precipitates the nitrate of copper white, the nitrate of iron a reddish yellow, the acetate of lead and the nitrate of mercury white. It combines with potash. It exists combined with alumine, in the mineral called *mellite*, or honey-stone. It is obtained by treating the pulverized mineral with boiling water; the water dissolves the acid, and a small portion of the alumine; the liquor is concentrated, and the alumine precipitated with alcohol. It is then filtered and carefully evaporated to dryness; a yellow mass is now obtained, which must be purified by several crystallizations. Klaproth was the discoverer of this acid.

Acid Menispermic. Extracted by Boullay, from the *menispermum cocculus*. Among its properties are those of not affecting lime-water, and of forming with barytes a soluble salt; of precipitating the nitrate of mercury gray, the nitrate of silver a deep yellow, the muriate of tin yellow, the muriate of gold a reddish brown; of not acting upon the solution of proto-sulphate of iron; of forming in the solution of the deuto-sulphate of iron, a deep green precipitate; of forming an abundant precipitate in the solution of the sulphate of magnesia, and of not being changed into oxalic acid, by nitric acid. It is obtained by treating a strong infusion of the nuts of the *menispermum cocculus*[*] with the nitrate of barytes; treating the precipitated menispermate of barytes with alcohol, in order to carry off the colouring matter, and afterwards treating it with sulphuric acid, to obtain the menispermic acid.

Acid Mephitic. See *Carbonic Acid*.

Acid Molybdous. Solid, white, soluble in water, sulphuric, hydro-chloric and nitric acids; reddens the tincture of litmus. It is composed of 100 of molybdenum, and 34 of oxygen. It is obtained by triturating with water a mixture of 1 part of molybdenum, and 2 parts of molybdic acid, and in boiling the liquor, which gives a blue precipitate.

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[*] A plant obtained from the Levant.

Acid Molybdic. White, solid, inodorous, little sapid, very soluble, reddens the tincture of litmus. Its specific gravity is 3·46. It volatilizes at a certain temperature, but if kept from contact with the air, it melts and crystallizes in cooling. Most of the bodies which have a certain affinity for oxygen, take from it a portion of this substance, and reduce it to the state of molybdous acid. It is formed of 100 of metal, and 50 of oxygen. It exists in molybdated lead; but is always obtained from the sulphuret of molybdenum, first by pulverizing and roasting, then heating it with a solution of potash; the molybdate which is formed is decomposed by sulphuric acid, and the molybdic acid is precipitated.

Acid Moric or Moroxylic. This acid crystallizes in very sharp needles of a yellowish colour and an acid taste. It reddens the tincture of litmus, and dissolves in water and alcohol. If heated in contact with the air, one portion is decomposed, and produces a gas in which the other portion volatilizes, and condenses itself into prismatic crystals. It forms with lime, a salt little soluble. This acid was discovered by Klaproth. It is found combined with lime, forming little brown grains on the bark of the white mulberry. It is obtained by boiling this bark in a large quantity of distilled water. This is evaporated, and the morate of lime is obtained; this latter substance is boiled with an excess of the acetate of lead, and the morate of lead which has been produced, is decomposed by sulphuretted hydrogen.

Acid Mucic. (From *mucus*, it being generally obtained from gum.) White, pulverizable, little sapid, scarcely soluble, it feebly reddens the tincture of litmus. In its decomposition by heat, it yields a peculiar acid, susceptible of crystallization. According to Scheele, ho discovered this acid, it is soluble in alcohol.—

It precipitates the waters of lime, barytes, and strontian, but the precipitate is dissolved anew in an excess of acid. It acts upon the nitrates of silver, and mercury, also upon the acetate, the nitrate and the hydro-chlorate of lead; but it does not act upon the salts of magnesia and alumine, upon the hydro-chlorate of tin and mercury, nor upon the sulphates of iron, zinc, manganese, and copper. This acid is always a product of art. It was first obtained by heating the sugar of milk with nitric acid; on this account it was called *saccholactic* acid, but it is now known to be afforded by all gums, and from thence is the term, mucic acid. In obtaining it from the sugar of milk, three parts of nitric acid are heated with that substance; in the bottom of the retort is found a white powder, which by washing may be rendered pure; this is the mucic acid. It is composed in weight of carbon, 33·69, of oxygen, 62·69, and hydrogen, 3·62. (*Gay.Lussac and Thenard.*) The results of Berzelius are a little different.

ACID MURIATIC. See *Hydro-chloric Acid.**

ACID PHLOGISTICATED MURIATIC. See *Chlorine.*

ACID HYPER-OXYGENATED MURIATIC. See *Oxide of Chlorine.*

ACID NANCEIC. See *Zumic Acid.*

ACID NITROUS. (*Acide Nitreux.*) The physical characters of this acid are very valuable and curious. It was for a long time considered as a gaseous body; but Dulong, who examined it with his ordinary sagacity, considers it as liquid at the ordinary temperature of the atmosphere. Its colour varies according to the degree of heat to which it is exposed, from 59° to 83°. It is orange coloured at 32°. Its density is 1·451; it boils at 83°. In contact with oxygen and the vapour of water, it is changed into nitric acid; inflamed bodies which are immersed in it continue to burn. It acts upon different bodies in much the same manner as nitric acid. If brought in contact with sulpuretted hydrogen, at the ordinary temperature, it precipitates the sulphur. It forms, with concentrated sulphuric acid, a crystalline compound decomposable by water. Nitrous acid is in volume composed of 1 of nitrogen and 2 of oxygen, or in weight of 100 of oxygen, and 44·25 of nitrogen. It is obtained by heating in a small retort, very dry neutral nitrate of lead; the acid passes over into a receiver surrounded with a cooling mixture.

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* They are synonymous terms, and so used in this work.

Nitric Acid. This substance was discovered in 1825 by Raimond Hill, who called it the *spirit of nitre*, because he had obtained it by heating a mixture of clay and the salt of nitre, (nitrate of potash.) It contains always a certain quantity of water, without which it cannot exist. According to Gay-Lussac, the specific gravity of that which contains the least water is 1·510 at 65°.

It is a colourless liquid, with a peculiar odour, of a taste extremely caustic, so much so, that it disorganizes animal matter with which it comes in contact. It reddens strongly the tincture of litmus. It boils, according to Thenard, at 187°, and decomposes at a red heat. The products of this decomposition are oxygen and water. It congeals at 60° below zero, but never becomes very solid. When highly concentrated, it is decomposed by the solar light as effectually as by red heat. Most combustible bodies decompose nitric acid by attracting its oxygen; the quantity of oxygen absorbed varies accord- to the affinity of the body for oxygen, and according to the temperature under which the experiment is made. This nitric acid may be transformed into *nitrous acid*, the *deutoxide of nitrogen*, the *protoxide of nitrogen*, and even *nitrogen*. Chlorine, iodine, and nitrogen have no action upon nitric acid; this is also the case with gold, platinum, iridium, rhodium, osmium, columbium, cerium, titanium, chromium, and tungsten. All the other elements, metallic and non-metallic, effect its decomposition at different temperatures. In their contact with this substance, metals pass to the state of an acid or an oxide, and in the latter case, the portion of nitric acid not decomposed almost always unites and forms a nitrate. Antimony and tin are exceptions to this rule. In some cases also, the water of the nitric acid is decomposed, and hydrogen in a state of gas, uniting with the nitrogen from a part of the nitric acid, combines and forms ammonia. From thence the nitrate of ammonia, which is observed in the solution of some metals in this acid. Sulphuric acid, abstracting the water which it contains, transforms it into oxygen and nitrous acid. It seems to possess the power of dissolving a large quantity of the deutoxide of nitrogen. In this case is obtained a mixture of nitric acid, of nitrous acid, of the deutoxide of nitrogen and of water. This mixture takes different colours according to the quantity of the deutoxide of nitrogen it contains.

Nitric acid attacks almost all vegetable substances which do not act as salifiable bases; it always yields to them a certain quantity of oxygen, often causing them to pass into the state of acids. Its action upon animal substances is also very energetic. It usually decomposes them, by decomposing itself, and gives rise to many of the compounds resulting from the union of oxygen, hydrogen, carbon, and nitrogen; among the substances thus produced are ammonia, hydro-cyanic acid, nitrous acid, malic, acetic, oxalic, and carbonic acids, and a peculiar yellow and detonating compound, which is considered as a combination of the hypo-nitrous acid with an animal substance.

Nitric acid is composed of 1 volume of nitrogen, and 2½ volumes of oxygen; or in weight, of 35·12 of nitrogen, and 100 of oxygen. The weight of its atom is

6·75. It has never been found free in nature. It indeed exists in places continually exposed to the decomposition of animal substances, or where substances containing it are gradually decomposed; but it is always united to bases, principally to lime, magnesia, and potash. It was formerly prepared by making a mixture of the nitrate of potash and argillite. This mixture was put into large stone retorts called *cuines;* to these were adapted stone receivers, and these *cuines* were placed under a long furnace, called a *galley-furnace;* potash and alumine combining, the acid was set free; the residue was heated with sulphuric acid in order to obtain alum. But as sulphuric acid is now furnished at a low price, it is found to be more advantageous to employ that for the decomposition of the nitrate of potash; this salt is introduced into cast iron cylinders which communicate with stone receivers; sulphuric acid and argillite are added to the nitrate of potash. The mixture is at first gently heated, the fire is then increased until the acid has ceased to come over. The acid thus obtained is not pure: it is coloured yellow, more or less, by the deutoxide of nitrogen; it also contains a little of muriatic acid, and a small quantity of sulphuric acid; this is abstracted by distilling it with a small quantity of the nitrate of potash; it is afterwards heated in the open air, in order to disengage the deutoxide of nitrogen, and the muriatic acid. In order to obtain the nitric acid in a pure state for medicinal purposes, add to the common acid the nitrate of barytes, until it cease to form any precipitate; then use with equal care the nitrate of silver; and for fear that a little of these nitrates may be retained, the acid should be distilled anew; it will then be perfectly pure. This is one of the acids in most common use. It is known in commerce under the name of *aqua fortis*, or strong water; when diluted, it is called single. It is much used as a re-agent; and in pharmacy, in order to prepare different salts, oxalic acid, oxygenated pomatum, &c.

ACID NITRO-HYDRO-CHLORIC. See *Acid Hydro-Chloro-Nitric.*

ACID NITRO-LEUCIC. Braconnot gives this name to the combination of nitric acid with leucine. According to him, this is an acid different from the nitro-saccharic acid, and susceptible of uniting with bases.

ACID NITRO-MURIATIC. See *Hydro-Chloro-Nitric.**

ACID NITRO-SACCHARIC. A name proposed by Braconnot to designate the combination which the nitric acid forms with a peculiar crystalline matter which results from the action of sulphuric acid upon gelatine. This acid is solid, crystallizes in prisms, is colourless and striated, fuses upon coals, forms with lime a salt not deliquescent; is little soluble in alcohol, and forms with the oxide of lead a detonating salt. Thenard properly regards the mineral acid which enters into its composition as the hypo-nitrous acid.

ACID OLEIC. The discovery of this acid and the study of its properties are due to Chevreul. It is liquid, colourless, of an oily consistence, a rancid odour and taste. Its specific gravity at 60° is 0·898. Heat decomposes it, except in a vacuum, where it volatilizes. It congeals at a little above 32°, and forms a crystalline mass. Water does not dissolve it, but it dissolves in alcohol; it unites to stearic and margaritic acids, and it decomposes the sub-carbonates. It exists in the fat of dead bodies; is obtained by treating pork grease with potash. It contains 3·95 of water to 100 of dry acid. In the dry state it is in weight composed of 7·69 of oxygen, 80·94 of carbon, and 11·35 of hydrogen.

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* In most English books of chemistry, the term *Nitro-Muriatic* is used to designate this substance, which is the *Aqua Regia* of the ancients. But, according to the present commonly received theory of chlorine, the term *hydro-chloro-nitric* is most correct, as designating its compounds. Yet the terms muriatic acid, muriates, &c., are already so firmly established by custom, that they will still continue to be used, notwithstanding their imperfect signification; it is however important that the chemical student should be familiar with the new nomenclature founded on the chloridic theory.

Acid Oxalic. White, solid, crystallizes in small fine prisms with four faces terminated by dihedral summits. Its taste is very strong, it deeply reddens the tincture of litmus. Heated in a retort it fuses in its water of crystallization; afterwards one part is decomposed, the other volatilizes and condenses in the neck of the retort. Submitted to a red heat, without being in contact with the air, it leaves no residue of charcoal. It is soluble in two parts of cold water, dissolves less easily in alcohol. Its affinity for lime is such, that it takes it from sulphuric acid. The oxalate which is thus formed is insoluble in an excess of oxalic acid. Modern chemists are not agreed as to the composition of this acid. MM. Gay-Lussac and Thenard consider it as found in weight of carbon 26·566, oxygen 70·589, hydrogen 2·745. Berzelius found it in weight, composed of carbon 33·35, of oxygen 66·41, or in volume of 2 of vapour of carbon and 3 of oxygen. M. Dulong considers it as composed of carbonic acid and hydrogen, and M. Dobereiner supposes it to be produced by a combination of one volume of carbonic acid with one volume of the oxide of carbon and one proportion of water. It is never found in nature but in combination with potash and lime. The first of these combinations exists in the *Oxalis Acetosella*, (wood sorrel,) the second in the root of the rhubarb.

The oxalic acid is in chemistry employed as a reagent, and in the arts it is used to remove colours whose bases are iron. The oxalic acid is obtained by treating in a retort sugar or starch with nitric acid. These substances are not usually transformed into oxalic acid at the first operation, unless nitric acid be in excess. The malic and acetic acids are obtained, and these are transformed into oxalic acid, by treating them with a new quantity of nitric acid. At first very large crystals are obtained, but as the crystallization is successively repeated, they are deprived of the nitric acid which they contain, and appear under the form of prisms, more and more delicate. This acid is also obtained by decomposing the oxalate of lead by sulphuretted hydrogen, filtering and evaporating the liquor; on cooling, the crystals are deposited.

Acid Per-Nitrous. See *Hypo-Nitrous Acid.*

Acid Phocenic. This acid results from the action of the alkalies upon phocenine. It is a colourless liquid, having a strong odour; it boils at 212°, remains liquid at 16°. It volatilizes with water without being decomposed, but is decomposed if distilled pure. It resembles the volatile oils in some of its characters; like them it is nflamed by the approach of an ignited body; it scarcely dissolves in water, but is readily dissolved in alcohol. Chevreul, to whom we are indebted for the discovery of this acid, found it, though in small quantities, in the oil of the dolphin and the porpoise, also in the berries of the snow-ball, (*viburnum opulus.*) The phocenic acid contains 9·89 parts of water to 100 of dry acid, or on a minute analysis is found to contain in weight, carbon 66·370, oxygen 26·030, hydrogen 7·580.

Acid Phosphatic. Dulong and some other chemists name thus the acid already described under the head of *hypo-phosphoric acid.* This acid was often described under the name of *phosphorous acid*, when of the four combinations of phosphorus with oxygen, this and the sulphuric alone had been discovered.

Acid Phosphorous. Liquid, colourless, inodorous, very acid, very soluble in water, decomposable by heat, and capable of forming with bases, salts which differ essentially from the phosphates and the hypo-phosphates. Dulong considers it as formed of 100 of phosphorus and 74·88 of oxygen. The weight of its atom is 4·67. This acid is not used in the arts. It was discovered by D

Phosphorous acid is obtained by treating the proto-chloride of phosphorus with water. It is sufficient to evaporate the water in order to obtain it pure.

Acid Phosphoric. This acid is white, solid, colourless, inodorous, heavier than water, at red heat it melts into colourless glass ; at this temperature it is decomposed by carbon, potassium, sodium, iron, zinc, tin, and some other metals. The products which are obtained vary according to the quantity of metal in relation to that of phosphoric acid. It acts upon silver in contact with the atmosphere but at an elevated temperature. Chemists are not agreed with respect to the composition of this acid. We consider it with Dulong as formed of 100 of phosphorus and 124·80 of oxygen. Its uses are not numerous. It is employed in some analyses. It is obtained by burning a piece of phosphorus under a bell-glass, upon mercury, in oxygen, or in atmospheric air. The acid which is formed is in flakes resembling snow. It is usually prepared by placing upon a sand-bath a tubulated retort furnished with an adapter and a spherical receiver terminated by two flasks of Woulfe's apparatus. Sometimes the two flasks are not added, and they are dispensed with by luting the joints. Into the retort is put eight parts of nitric acid ; this being made to boil, one part of phosphorus cut into small pieces is added. When part of the liquid is distilled, the apparatus is left to cool, the distilled product poured into a retort, and the operation continued until the gas ceases to be evolved. The liquid in the retort is put into a platina crucible where it is heated until it become vitrified. Phosphoric acid is also procured by decomposing the phosphate of ammonia by heat, or the phosphate of barytes by sulphuric acid. Phosphoric acid does not exist free in nature, but it makes part of the bones of animals, and is found combined with several different oxides.

Acid Prussic. See *Hydro-cyanic Acid.* The combination of this acid with iron was long known and used as a pigment, by the name of *Prussian blue*, before its nature was understood.

Acid Prussic Oxygenated. See *Chloro-cyanic Acid.*

Acid Pseudo-Kinic. Scarcely known. Discovered by Vauquelin, in the bark of the *Strychnos pseudo-kina.*

Acid Pyro-Acetic. See *Pyro-acetic spirit.*

Acid Pyro-Ligneous. See *Acetic Acid.*

Acid Pyro-Citric. It is one of the products of the decomposition of citric acid. It is solid, white, inodorous, very soluble in water and alcohol; it reddens the tincture of litmus, and is peculiar in acting upon no metallic solutions, except the acetate of lead, and the protonitrate of mercury. According to M. Lassaigne, to whom we owe its discovery, it is composed of 47·5 of carbon, 43·5 of oxygen, and 9 of hydrogen.

Acid Pyro-Malic. This is one of the products of the action of heat upon malic acid. It is solid, capable of crystallizing, fuses at 47·5, and crystallizes in cooling. It is soluble in ten parts of water, and dissolves much more easily in rectified alcohol. It combines with salifiable bases and forms peculiar salts.

Acid Pyro-Mucic. This is one of the products of the distillation of mucic acid. It is white, inodorous, very sapid, fuses at 298°; volatilizes with a little more heat, and on cooling condenses into a crystalline mass. It is soluble in twenty-six parts of cold water. Alcohol and warm water dissolve it more readily. It does not precipitate the acetate of lead. M. Houton-Labillardière, the discoverer, regards it as formed of 52·118 of carbon, 45·806 of oxygen, and 2·111 of hydrogen.

Acid Pyro-Tartaric. It is obtained by distilling tartaric acid. Like the preceding acid, it is found in the liquid products of distillation. It is white, crystalline, very sapid, fuses if exposed to heat in a close partly decomposes at a temperature a little more elevated, is easily dissolved in water, crystallizes by evaporation, and combines with different salifiable bases.

Acid Rheumic. An acid found in the stems of the rhubarb, (*Rheum tartaricum.*) This is the oxalic acid.

Acid Saccharine. The same as the oxalic acid. (See this word.)

Acid Saccho-Lactic. See *Mucic Acid.*

Acid Sebacic. Its discovery and the study of its properties are due to M. Thenard. It is one of the products of the distillation of fat. It is inodorous, little sapid, heavier than water, and susceptible of crystallization in small white needles. Heat at first fuses and then decomposes it. It is very soluble in warm water, and little so in cold water; boiling water which is saturated with it takes a massy form on cooling. It is soluble in alcohol, combines readily with the alkalies, and forms with them neutral and soluble salts. It does not contain nitrogen.

Acid Selenic. Solid, white, crystalline, inodorous, very sapid, strongly reddens the tincture of litmus. Heat volatilizes without decomposing it. It attracts moisture from the air, is easily dissolved in water and in alcohol. Many combustible bodies decompose it by the aid of heat. According to Berzelius, it is composed of 100 of selenium and of 40·33 of oxygen. It is analogous to phosphoric acid, in being obtained by burning its base, selenium, in oxygen, or in treating it with nitric acid. It is not known to be of use.

Acid Sorbic. See *Malic Acid.*

Acid Stearic. Solid, white, inodorous, insipid, lighter than water, fuses at 104°, and in this state reddens the tincture of litmus; it crystallizes on cooling; it is insoluble in water, but very soluble in alcohol; nitric acid decomposes it; it burns like wax, when heated in contact with the air. In its properties it resembles margaritic acid. It is never found in nature, but is obtained by saponifying fat. In 100 parts it contains 3·52 of water; abstracting the water, it is found to consist of 7·377 of oxygen, of 80·154 of carbon, and 12·478 of hydrogen. (For further particulars, see chemical researches of M. Chevreul upon fat.)

Acid Stannic. See *Oxide of Tin*, (*Per*.)

Acid Suberic. It is obtained from cork (*Quercus suber*) by nitric acid. It is white, pulverulent, scarcely possessing the character of an acid; it however forms combinations with the alkalies. It soon fuses on exposure to heat, and then volatilizes; it is scarcely soluble in water, is more so in alcohol; it neither precipitates the sulphate of copper nor that of zinc. According to M. Bussy, it is composed of 58·30 of carbon, 34 of oxygen, and 7·67 of hydrogen.

Acid Succinic. Solid, susceptible of crystallization in flattened prisms, is without colour, of a sour taste. It is little soluble in water; heat decomposes one part, in which the other part vaporizes; it precipitates the peroxidated salts of iron, does not precipitate those of the protoxide of manganese. According to Berzelius, it is in weight composed of 47·888 of oxygen and 4·512 of hydrogen. It is found in amber and turpentine. It is employed in medicine. Succinic acid is generally extracted from amber, (*succin*.) For this purpose, a certain quantity of amber is introduced into a stone retort, to which is fitted an adopter and a receiver terminated by a tube. It is gradually heated until the acid ceases to be disengaged, the receiver being cooled from time to time. One part of the acid volatilizes, and attaches itself to the sides of the vessels; this is the purest. The other is found in a liquid state, mixed with an oil of disagreeable odour. The oil is separated and the liquor evaporated as much as possible by a current of cold air. Crystals of the acid are obtained, then re-united to the part volatilized; they are combined with soda: and formed a soluble salt, which is decomposed by the nitrate of lead. Before adding the nitrate of lead, the liquor should be treated with charcoal. Lastly, the succinate of lead is decomposed by sulphuric acid, and the succinic acid is obtained very pure.

Acid Sulpho-Cyanic. This acid is sometimes called *sulphuretted chyazic acid*. It is a transparent, colourless liquid, reddens litmus paper, and combines with alkalies, forming neutral compounds.

Acid Sulpho-Napthalic. This acid results from the combination of sulphuric acid and napthaline.

Acid Sulpho-Vinic. An acid of but little importance, generated during the process of preparing sulphuric ether.

Acid Sulphuric. *Oil of Vitriol.* Its discovery, which is dated from the fifteenth century, is due to Basil Valentine, who obtained it by distilling green copperas, (sulphate of iron.) It is a colourless liquid, without odour, of an oily appearance, of a taste extremely caustic, and of course strongly reddens the tincture of litmus. It usually contains one fifth of its weight of water, and in this state its density according to Thenard is 1·842. It congeals at —12° when concentrated, and at 32° when diluted with water. Exposed to the action of fire it volatilizes without being decomposed; if however the temperature is very elevated, it will change into 2 volumes of sulphuric acid and 1 volume of oxygen. It attracts so much humidity from the air as to double its weight. A great number of combustible bodies decompose it at temperatures more or less elevated. It then yields a part or the whole of its oxygen; and the sulphur is differently affected according to the nature of the decomposing substances. The water which it contains is also often decomposed. Like nitric acid, there are few metals (and these are the same in both cases) which are not acted upon by it. It attacks vegetable and animal substances, and charcoal, disengaging sulphurous acid.

It produces in its mixture with water a great elimination of caloric, owing to the condensation of the mixture; while 1 part of acid and 4 of pounded ice or snow produce a considerable degree of cold, which cold is owing to the sudden liquefaction of the ice or snow. This acid is formed of 2 volumes of sulphurous acid, and 1 volume of oxygen; or in weight of 100 sulphur, and 150 oxygen. (abstracting the water which it contained.) The weight of its atom is 5.

The existence of sulphuric acid free, in nature, is still doubtful. Humboldt discovered in America waters that owed their acidity to it. It has been said to have been found in a solid state in some grottoes, but it was probably in the state of an acid sulphate of lime. It is in many countries an important branch of manufacture. A mixture of 8 parts of sulphur, and 1 part of nitrate of potash, are heated in a large capsule, placed in a capacious chamber of lead. The floor of this chamber being covered with water, every thing is ready for the preparation of the acid. The sulphur and the saltpetre are inflamed and burned. When the combustion is finished, the sulphate of potash which remains in the capsule is withdrawn, and replaced by a new mixture of saltpetre and sulphur. The air in the chamber is renewed by opening the door and valve; these openings being closed, the mixture is again inflamed, and this operation is necessarily performed until the acid is at 40° of Baume's areometer;* it is then drawn from the chamber by means of a syphon, which is conducted into a large kettle of lead, in which the acid is heated until it marks 55° upon the areometer; it is then put into earthen and platina vessels which are used instead of retorts; the acid is then heated until it marks 66° upon the areometer; in this state it is used in commerce. Although by some of the last operations the sulphuric acid was separated from different substances, which rendered it impure, such as a large quantity of water, sulphurous acid, and a small quantity of nitrous acid; it still retains some sulphate of lead, and sometimes organic carbonated matter. By distilling, it is obtained very pure, but the precaution must be taken to put into the retort some pieces of glass or porcelain, and some plates of platina; these serve to conduct caloric, and to establish an equilibrium between the layers of the acid.

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* Commonly called hydrometer.

It is evident that in burning a mixture of sulphur and nitrate of potash, sulphurous and nitrous acids are produced, or at least the deutoxide of nitrogen, which by its contact with the oxygen of the air becomes nitrous acid. These two acids, which when dry have no action upon each other, present when humid remarkable phenomena. One portion of nitrous acid is decomposed, and yields oxygen to the sulphurous acid, which, passing into the state of sulphuric acid, combines with a small quantity of water and nitrous acid, and gives a deposite of little white crystals. Water dissolves the sulphuric acid contained in the crystals, and the nitrous acid appears in the form of yellow vapour. The potash which was obtained from the decomposition of the nitrate of potash, combines with a portion of sulphuric acid and forms a sulphate. It has been seen that it was only neoessary to introduce into the leaden chamber the sulphurous gas, and the deutoxide of nitrogen, with atmospheric air to supply another portion of oxygen; we may arrive at the same result, by burning sulphur only in the leaden chamber, and procuring the deutoxide of nitrogen, by the action of nitric acid upon starch. On account of the oxalic acid which is the result of the latter process, this, in certain cases, is more economical than the former. The uses of sulphuric acid are very numerous; it is employed as a re-agent to detect barytes, and to prepare sulphuric ether, nitric acid, *muriatic* acid, &c.

Acid Sulphuric of Nordhausen. Although the history of this acid belongs to that of sulphuric acid, it may deserve a separate notice. According to M. Bussy it is a brown liquid, which is chiefly prepared at Nordhausen, by distilling the sulphate of iron, united to a small quantity of the nitrate of potash. It may also be obtained by the distillation of such sulphates as can be decomposed by heat. By slowly heating this acid, a crystalline mass is extracted, which is the anhydrous sulphuric acid. In this state, a little below 77°, it is white, opaque, absorbs humidity from the air, fuses even at the temperature of 77°, and forms a liquid, whose density is 1·57. It dissolves sulphur, and this solution may be either brown, green, or blue. It also dissolves indigo, forming a solution of a beautiful purple colour. The sulphuric acid of Nordhausen is a solution of sulphurous acid and ordinary sulphuric acid.

Acid Sulphurous. (*Acide Sulphureux.*) A colourless gas, of a strong and pungent odour, at first reddening the tincture of litmus, and then destroying it. According to Thenard, its density is 2·234. Heat alone can decompose it. When moist, a cold of —58° does not liquefy it; but M. Bussy, who made very interesting observations upon this acid, liquefied it at the ordinary pressure, by immersing it in a refrigerating mixture composed of two parts of ice and one of common salt; the gas in this operation must be very dry. When liquefied, it is a colourless, transparent liquid, whose density is 1·45. It produces so much cold in vaporizing, as to induce the belief that it might be liquefied in this manner; and, by employing a certain pressure, this has been accomplished. Sulphurous acid gas does not combine with oxygen at any temperature; but it may be decomposed at different temperatures, (never by cold,) by different combustible bodies, which absorb its oxygen; it also forms combinations with sulphur. Sulphuretted hydrogen decomposes it by decomposing itself; water and sulphur are the result; this decomposition will be instantaneous, if the gases are not very dry. Water, at the ordinary pressure of the atmosphere and at 68°, dissolves 37 times its volume. Sulphurous acid contains a volume of oxygen equal to itself in weight; it is, according to Berzelius, composed of 100 of sulphur and 99·44 of oxygen. This is chiefly used in medicine in the treatment of cutaneous diseases; and as for this use it is not injured by a mixture of atmospheric air, it may be procured by burning sulphur upon a chafing dish. It is prepared in this manner for the bleaching of silk; but in order to obtain it pure, it is necessary to treat a vegetable substance, wood for example, with concentrated sulphuric acid; mercury may be substituted for wood; the sulphuric acid, yielding part of its oxygen, is reduced to the state of sulphurous acid.

Acid Tartaric. (*Acide Tartrique.*) Solid, colourless, inodorous, crystallizable, of a strong acid taste. Heat decomposes it, and in its decomposition, it gives, among other products, a peculiar acid. (See pyro-tartaric acid.) But if this experiment is made in contact with the atmosphere, the acid inflames, and produces water and carbonic acid. It is very soluble in water, much less so in alcohol; nitric acid changes it into oxalic acid. It precipitates the waters of lime, barytes, strontian, and the acetate of lead. These tartrates are soluble in an excess of acid; this is not the case with the precipitates which it forms in the concentrated solutions of potash, soda, and ammonia. According to the experiments of M. Soubeireau, tartaric acid mixed with boracic acid and put in a damp place, absorbs a certain quantity of water, and liquefies, from whence he concludes that there can be a combination between them, but that their affinity is very feeble. According to MM. Gay-Lussac and Thenard, tartaric acid is in weight composed of carbon 24·050, oxygen 69·321, hydrogen 6·629. It has not yet been found pure in nature, but always in combination with lime and potash. From this last combination it is usually extracted. For this purpose let the acid tartrate of potash be in a fine powder, dissolvei t in 15 or 20 parts of boiling water, and saturate the excess of acid by a sufficient quantity of powdered chalk (carbonate of lime,); filter the liquor, and wash the tartrate of lime which is thus obtained: into the filtered liquor pour a solution of the chloride of lime; there will be a double decomposition, and a new deposite of tartrate of lime: the substances obtained should be re-united as above, and treated by three fifths of their weight of concentrated sulphuric acid, diluted with a great quantity of water, because the sulphate of lime which is formed, solidifies a great proportion. If the tartrate of lime be not well washed, it is easily perceived by the vapours of muriatic acid gas which are disengaged. After the contact of the sulphuric acid has been prolonged seven or eight days, water is added, the whole shaken together, and left to settle; it is then decanted, the residuum washed, the liquors re-united and evaporated; they are boiled for a moment with a small quantity of animal charcoal, again decanted, and the acid left to crystallize. Care must be taken not to use too much of the animal charcoal, for this, always containing phosphate of lime, would present to the sulphuric acid a new occasion to exercise the force with which it acts upon most salts. It would set at liberty the phosphoric acid, and would oppose the crystallization of the vegetable acid. In order to obtain the acid perfectly pure it is necessary to boil it with litharge (the protoxide of lead,) to filter it, to pass it into a current of sulphureted hydrogen, to filter it again, and to drive off by heat the sulphuretted hydrogen which might remain. The tartaric acid is used in medicine.

Acid Tungstic. Solid, yellow, inodorous, insipid; when brought in contact with deoxygenating bodies at an elevated temperature, it yields a portion of its oxygen, and passes to the state of a deutoxide and even a protoxide. It forms soluble salts with soda, potash, and ammonia. It is composed of 100 of metal, and 25 of oxygen. It has no use. It is extracted from the mineral called *wolfram*, (tungstate of iron and manganese,) by heating it with muriatic acid, which dissolves the oxides of iron and manganese, but does not act upon the tungstic acid.

Acid Vegeto-Sulphuric. M. Braconnot proposes this name for a combination of sulphuric or hyposulphuric acid with a vegetable substance. This acid is obtained by treating woody fibre, (*ligneux*,) with sulphuric acid.

Acid Zumic. (From *Zume*, yeast.) This acid, the existence of which has been considered doubtful, was discovered by M. Braconnot, in different vegetable substances, which had passed through the acid fermentation. According to this chemist, it is an uncrystallizable liquor, almost colourless, and of a very acid taste. Heat decomposes it. It furnishes carbon and acetic acid, and forms soluble salts with the greater part of the salifiable bases. This acid is obtained by evaporating with a slow heat the soured juice of the red beet. When nearly soluble, it is treated with alcohol; the solution is filtered and evaporated to the consistence of sirup; this is diluted with water, saturated with the carbonate of zinc, and filtered; the zumate of zinc is crystallized, redissolved, and decomposed by barytes; the zumate of barytes is in its turn decomposed by sulphuric acid.

Acier. See *Steel.*

Adipocire. (From *adeps*, fat, and *cera*, wax.) A peculiar fat-like substance, formed by the spontaneous change of animal matter, in certain situations. See *fat of dead bodies.*

Adopter. (*Alonge.*) A tube usually of glass, which serves to place the receiver at a greater distance from the distilling vessel.

Affinity. See *Attraction.*

Air Atmospheric. The atmosphere envelopes the globe to an extent not exactly known. It is generally supposed to be about forty-five miles in height; surrounding the surface of the earth, it necessarily contains all the gaseous substances which pass off from it, and all of the new combinations, which the elements that compose this atmospheric air are capable of forming. It was, however, for a long time regarded as a simple body, and ranked as one of the four elements which formed all the combinations in nature. This opinion, formerly received by all the learned, was not entirely destroyed but by the experiments of Lavoisier, although John Rey, more than a century earlier, had attempted to show its fallacy. Lavoisier proved by experiments that the air was composed of two gases, which possessed properties very different, and whose proportions he attempted to determine. Although not very exact, yet his experiments threw much light upon the subject. According to the more precise experiments of modern chemists, the atmospheric air is formed of 21 of oxygen gas, and 79 of nitrogen; it also contains a variable quantity of aqueous vapour, and one thousandth part carbonic acid. Other gases which it may contain enter so readily into combinations with it, that they are not to be found in the atmospheric air, but near the places where they are produced; the quantity of other gases being very small in proportion to the whole mass of the atmosphere, and the mixture of gases even of different densities taking place with facility, they are so disseminated as not to be easily detected by analysis. Carbonic acid is the only gas which is to be found in any considerable quantity in the atmosphere; the combustion of vegetable substances, and the respiration of animals, continually furnish it in proportions sufficiently great to affect the purity of the air; but it is immediately decomposed by vegetables, which, appropriating to themselves the carbonic acid of the atmosphere, disengage almost all the oxygen which it contains. In countries where a low temperature, during a part of the year, prevents the developement of most kinds of vegetation, the winds which agitate the atmosphere, and the many mosses and resinous evergreens maintain a continual equilibrium in the proportion of carbonic acid diffused through the atmosphere.

Atmospheric air is a colourless gas, inodorous, but susceptible of transmitting odours: it is compressible, and ponderable. Its specific gravity at 60°, and the barometer at 30 inches, is usually considered as = 1; its density being taken as a unit in estimating the density of the gases. It is about 828·59 times as light as its bulk of water; 100 cubical inches weighing 30·5 grains. Its chemical properties are somewhat similar to those of oxygen. Almost all combustible bodies can decompose it at various temperatures. It is always the oxygen which it contains that is absorbed. Many bodies absorb humidity from the atmosphere, the alkalies attract the carbonic acid which it contains, and on long exposure to it, become sub-carbonates. Its uses are very numerous, since it is essential to respiration and combustion, and it yields oxygen to many substances in chemical operations. The natural currents which it forms are employed as a moving force, as also its property of being compressed, and of being dilated by heat.

AIR DEPHLOGISTIC. The same as *Oxygen.*

AIR FIXED. *Carbonic Acid.*

AIR INFLAMMABLE. See *Hydrogen.*

AIR VITIATED. A name given by ancient chemists to *nitrogen.*

AIR VITAL. One of the names of oxygen.

Albumen. Is an animal substance in the state of a solid; it is white, insipid, inodorous, heavier than water; it is decomposed by heat, giving off the sub-carbonate of ammonia, &c. It also presents other characters similar to fibrine, but dissolves better in potash and soda. When brought in contact with water which contains a little of the deutoxide of hydrogen, it does not give off oxygen like fibrine. (Thenard, vol. iv. p. 359.) If dried, it becomes hard, yellow, semi-transparent; but if brought in contact with water, it again assumes its usual form. Solid albumen is obtained by heating water in which the white of eggs has been diluted, and washing the coagulum. The albumen of the eggs does not in its nature experience alteration by spontaneous evaporation, and can preserve itself indefinitely. Liquid albumen is coagulated by heat and by alcohol; it forms with all strong acids, especially the nitric, compounds which are white, acid, and little soluble. Phosphoric and acetic acids do not, however, affect it; chlorine and iodine act upon it, and also tannin. Potash and soda prevent its being coagulated by fire. With the exception of the alkaline salts, almost all the salts in solution are decomposed by albumen, which forms a combination with their oxides, and a small quantity of their acids, unless we except the hydro-chloric or hydriodic acids; for in this case the precipitate would only be albumen with the metallic chloride or oxide.

Albumen on account of its power of effecting decomposition is frequently used in cases of poisoning with metallic salts. It must not, however, be used in too great quantities, as an excess would redissolve a part of the precipitate which should be formed. According to MM. Gay-Lussac and Thenard, albumen is composed of 52·883 of carbon, 23·872 of oxygen, 7·540 of hydrogen, and 15·705 of nitrogen, also a small quantity of sulphur. Albumen united to water and some salts, constitutes white of the egg; it is also found in all parts of animals, particularly in the liquid parts. Its uses are various, the most common is that of clarifying different liquids.

Alcahest. An Arabic word to express a universal dissolvent, which was pretended by Paracelsus and some other alchymists to have been discovered.

Alcaligen. One of the ancient names for nitrogen, this being supposed to enter into the composition of all the alkalies.

Alchemy. (*Alchemia.*) That branch of chemistry which relates to the changing metals into gold; forming a panacea or universal remedy; an alcahest or universal solvent, and many other absurdities.

Alcoates. By these we understand such definite compounds as are formed by the solution of certain bodies in alcohol; this has been proved of the chlorides of calcium, manganese, and zinc, and of the nitrates of lime and magnesia. All these bodies were found by Mr. Graham to unite with alcohol in definite proportions, and yield crystalline compounds which are deliquescent and soluble both in water and alcohol. Alcoates are formed by dissolving the substances in pure alcohol by means of heat, when on cooling, a group of crystals more or less irregular is deposited. The salt and alcohol employed for this purpose should be free from water, as a small quantity of water prevents crystallization.

Alcohol. (*Alcool.*) A colourless liquor, very volatile, of a strong and agreeable odour, a burning taste, boiling at 174°, and congealing at 90°. Its density when pure is, according to M. Gay-Lussac, 0·7923 at 60°. According to the same chemist, the density of its vapour is 1·613. A high temperature completely decomposes it; it is easily inflamed on the approach of a burning body or by an electric spark. Phosphorus, sulphur, and iodine are little soluble in alcohol. The vapour of sulphur forms with it a peculiar compound. Chlorine produces with it an oily substance, accompanied with muriatic and carbonic acids. This oily matter seems to be a combination of chlorine and of per-carburetted hydrogen. When equal parts of alcohol and distilled water are mixed, the liquids expand and there is an elevation of temperature. Potash, soda, ammonia, and the vegetable alkalies are soluble in alcohol. If a small fragment of barytes is put into anhydrous alcohol, it will not dissolve, but on account of the little water it contains will expand. (*Thenard's Treatise on Chemistry, vol.* iv. *p.* 133.)

The action of the acids upon alcohol produces peculiar substances. (See *Ether.*) Alcohol in general dissolves all deliquescent bodies; it dissolves the deutochloride of mercury, camphor, the essential oils, sugar, manna, and castor oil. It dissolves the animal oils but in a slight degree. Alcohol is in weight, composed of carbon 51·98, oxygen 34·32, hydrogen 13·70, or in volume of 1 of bi-carburetted hydrogen, and 1 of vapour of water. Alcohol exists not ready formed in nature, it is formed during the fermentation of sugared substances; and as it is very volatile, it is obtained by submitting these substances to distillation. It usually contains water, which cannot be abstracted but by rectifying it with substances which have a strong affinity for water, as the chloride of calcium, and the acetate of potash. In the arts the preparation of alcohol is carried on by means of an apparatus too complicated to be described here. Alcohol is employed in pharmacy, in the preparation of spirituous liquors, in the making of varnish, &c.; it is of great use in pharmacy or the preparation of medicine.

Alembic. (*Alambic.*) A chemical utensil made of glass, metal, or earthen ware, and adapted to receive volatile products from retorts. It consists of a body, to which is fitted a conical head, and out of this head descends laterally, a beak to be inserted into the receiver

This part of a chemical apparatus, used for distilling or separating volatile products, by first raising them by heat, and then condensing them into a liquid state by cold, is of extensive use in a variety of operations.

Alkali Fixed Mineral. Soda. See *Oxide of Sodium.*

Alkali Fixed Vegetable. See *Oxide of Potassium.*

Alkalies. Under the name of alkalies is included a certain number of metallic oxides, which possess peculiar properties, or rather, which present the character of oxides in a more marked degree than others. They unite more readily to acids than the other oxides, they redden the curcuma paper, and restore to the tincture of litmus the blue tint which had been changed to red by the acids. They are more or less sapid, sometimes even caustic. Such are the oxides of potassium, sodium, calcium, strontium, barium, &c. (See these oxides.)

Alkalies Vegetable. These are the immediate principles of vegetables, remarkable in this, that it is almost always to them, that vegetables owe their active properties, since they can combine with acids, and form peculiar salts, which often have more action upon the animal economy than the bases themselves ; they always contain a certain quantity of nitrogen. These bodies possess many properties similar to the resins ; like them they are insoluble, or little soluble in water, while on the contrary they are soluble in alcohol, which circumstance has led many chemists to suppose that they were only a combination of ammonia with a modified resinous matter which some have named sub-resin. As this hypothesis is not sufficiently supported we shall continue with MM. Pelletier and Caventon, to regard them as a separate class in the immediate principles of vegetables. Carbon is the predominant element in their composition.

Alloy or **Allay.**[*] A great number of metals can combine with other metals, and the result of this combination is called an alloy. Such combinations are termed *amalgams* when mercury enters into their compositions, *binary* alloys when they result from the union of two metals, *ternary*, *quarternary*, &c., when they are composed of three or four metals. The affinity of metals for each other being feeble, it follows that alloys are made in various proportions, and that these properties differ little from those of the metals which compose them. In natural alloys however, the proportions appear constant; also in some of those which are artificial, and which may be made to crystallize. They are generally more brittle than the metals, and sometimes a brittle alloy is obtained from two ductile metals; the reverse of this is not often. Their density is sometimes greater, sometimes less, than the mean density of the constituents; their fusibility is often increased. Alloys are usually prepared by heating together the metals of which they are composed; it is thus that lead is separated from copper; this process is called *eliquation*; if the metal is volatile, it may be driven off by a strong heat. Platina is obtained by the latter mode. There are few natural alloys which do not contain either arsenic, lead, or antimony. Among the alloys employed in the arts with amalgams, are those of tin; this is employed in the manufacture of looking glasses. For this purpose, is spread out upon a flat table, a leaf of tin, which is then covered with mercury; the glass being applied, the amalgam remains upon its surface.

An amalgam of silver is formed of 1 of silver and 8 of mercury. It is obtained by heating to redness, 1 part of small pieces of silver, and throwing them into a sufficient quantity of mercury, (for example 16 parts) which has been previously heated; the amalgam should be shaken, then pressed in a chamois skin; the mercury in excess passes out, and a soft amalgam is obtained; this is used for *silvering*. That of bismuth, formed of 1 of that metal, and 4 of mercury, is employed for silvering glass globes. Amalgam of gold is prepared like that of silver; it is used for gilding brass. Among the binary alloys, is 1 of copper, with 9 of gold; this is used for coin, vases of different kinds, and ornaments of gold. An alloy of 1 of copper, and 9 of silver, is also employed in making coin and other articles of silver. That of 100 of copper, and 11 of tin, is used in making guns. That of 78 of copper and 22 of tin, is called brass; that of 2 of copper, and about 1 of zinc, constitutes yellow copper, whose uses are well known. That of 1 of tin and 2 of lead, is used under the name of *plumber's* solder.* That of 8 of tin and 1 of iron, is employed in tinning copper An alloy of iron and tin constitutes what is called white iron, but the alloy takes place only upon the surface of the plates of iron. An alloy of 20 of antimony, and 80 of lead, is used in the manufacture of printing types. Among the compound alloys, there are few which present any remarkable properties, except that of 8 of bismuth, 5 of lead, und 3 of tin; this melts in boiling water—if a small quantity of mercury is added, it becomes still more fusible; it is often used for plugging the teeth. A small piece is introduced into the cavity of the tooth; this is melted by applying to it a heated metal. While in this soft heated state, it is pressed upon by the finger, covered with a thimble of Indian rubber. The different alloys are easily prepared; it is only necessary to stir the mixture when it is fused, that layers of different densities may not be formed.

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[*] French term, *Alliages*:

ALUDELS. These are pots without bottoms, and which may be so adjusted to each other as to form pipes.

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* Webster says, equal parts of tin and lead.

Alum. Under this name is known a salt whose composition varies, but which has always for its base, the sulphate of alumine, united to the sulphate of potash, or the sulphate of ammonia, and sometimes to both at the same time. It is true that for the sulphate of alumine, might be substituted sulphates, whose oxides like the oxides of alumen, should contain 3 atoms of oxygen for 1 of the metal, (such as the peroxide of iron, tritoxides of manganese and chrome,) but although the same laws of composition would exist, the compound could not properly speaking be called alum. Alum is then a double or triple salt, without colour, reddening the tincture of litmus, soluble in its own weight of boiling water, and in 15 parts of cold water. If submitted to the action of fire, it melts in its own water of crystallization, afterwards swells, loses its water of crystallization, and forms a white mass known by the name of calcined alum. Water has little action upon it. If heated still more intensely, there will remain only the alumine and the sulphate of potash, when the alum is not based upon ammonia. Alum usually crystallizes in octohedrals, but when it contains a little excess of potash or alumine, it takes the cubic form. Heated with sugar or a vegetable substance containing an abundance of carbon, it forms a product called pyrophorus. (See this word.) If into a solution of alum is introduced potash or soda until the excess of the acid be saturated, the precipitate which is formed is a double sub-sulphate.

Alum based upon potash is formed of sulphate of alumine 36·85, sulphate of potash 13·15, water 45·00. That based upon ammonia, is composed of sulphate of alumine 38·88, sulphate of ammonia 12·96, water 48·15. Alum is employed in medicine, and often in the arts. In washing clothes it is used for purifying the water; tallow chandlers use it to give solidity to the tallow, &c. Alum is not common in nature, but the elements of which it is composed are often found. It is not unusually prepared by a direct process. When it is already formed, as at Solfaterra, near Naples, it is sufficient to lixiviate the earths which contain it, and to crystallize the liquor. In the neighbourhood of Vesuvius, it is in the state of an impure sub-sulphate of potash and alumine; it is roasted, exposed to the air, and alum is then obtained from it, as in the process already described. In France almost all the alum is obtained from natural mixtures, which form with argillite; these mixtures form extensive beds, in many departments, particularly in the north. It is sufficient to expose these substances to the air, and to keep them moist during a certain time; the proto-sulphate of iron, and the sulphate of alumine are soon formed; these are lixiviated, evaporated, and crystals of the sulphate of iron are formed; the mother waters are treated by the sulphate of potash and alum is obtained; this is purified by a new crystallization.

Alum (*Alum*) **Calcined.** Common alum which has been fused and deprived of its water of crystallization.

Alumine. See *Oxide of Aluminum.*

Aluminum. This metal has never been procured in a state of purity. It appears to have been obtained only in small quantities, alloyed with iron and steel, but it has never been separated from them. In combination with oxygen, under the form of *alumine*, it is extensively diffused through nature, though seldom pure.

Amalgams. These are combinations of mercury with the metals. See *Alloys.*

Amberine. A brilliant brown substance, insipid, almost inodorous, fusible at 86°, volatilizes, and partly decomposes at a temperature a little above that of boiling water. Nitric acid transforms it into *amberic* (*ambréique*) *acid.* (See this word.) Water does not dissolve it; this is not the case with ether and alcohol, for it was obtained by Pelletier and Caventou, by treating ambergris with the last named liquid.

Amer.[*] By this name is designated a yellow substance which is obtained by treating muscular flesh with nitric acid.

Amidon. See *Starch.*

Amidine.[†] A peculiar substance, spontaneously produced from the jelly of starch. According to M. de Saussure, it is distinguished from inulin, in being like starch coloured blue by iodine, little soluble in cold water, not forming jelly with boiling water, but a viscous solution with potash; it differs from artificial gum, in not being soluble in all proportions in cold water, in colouring blue the aqueous solution of iodine, and in forming with water a solution which is congealed by the sub-acetate of lead.

Ammonia gaseous. Ammoniacal gas is colourless, of a very pungent odour; its specific gravity, compared to that of the air, is 0·5912. It gives a deep green colour to the tincture of violets, extinguishes combustion, and liquefies when exposed to a low heat. A small quantity only is decomposed, when exposed to an elevated temperature; but if at this temperature it is brought in contact with metallic wire, particularly that of iron or copper, it is entirely decomposed, and changed into hydrogen and nitrogen. As these metallic wires experience no alteration, the effect of ammoniacal gas has been attributed to the multiplying of the points of contact, increasing of course the temperature, and thus favouring the decomposition of the gas. The same phenomena may be produced by substituting for the metallic wires, sand, fragments of glass, porcelain, &c. Oxygen with heat decomposes the ammoniacal gas, forming a small proportion of nitric acid. Iodine readily combines with this gas; the result is a liquid iodide of ammonia. Chlorine also decomposes a portion of ammoniacal gas; the result is a hydro-chlorate of ammonia, and nitrogen is set free. Water dissolves near 780 times its volume at the ordinary temperature and pressure; it is then known under the name of liquid ammonia. Owing to this great affinity, a piece of ice introduced into a jar of ammoniacal gas, soon becomes liquid.

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[*] A term in the French language, signifying bitter.

[†] From *Amidon*, starch.

Ammonia liquid. It was formerly known under the name of *volatile alkali*, or spirit of hartshorn. It presents similar characters to the gas; if submitted to the temperature of 212°, it gives off the greatest part or the whole of the gas which it contains. It precipitates yellowish green with the muriate of platina, does not precipitate the nitrate of silver, forms in the solution of the sulphate of magnesia a white precipitate, which is an ammoniaco-magnesian-sulphate, and gives to the solution of the sulphate of copper, when in excess, a beautiful blue colour. Ammonia dissolves zinc, oxidating it, and disengaging hydrogen, which proceeds from a small quantity of decomposed water. It dissolves copper, but without any disengagement of gas; the solution is colourless, but if exposed to the air, it absorbs oxygen, and takes a blue colour. It also dissolves a number of oxides, particularly when they are hydrated; these are the oxide of silver, the deutoxide of arsenic, the deutoxides and the tritoxides of antimony, the oxide of cadmium, the protoxide of iron, the deutoxide of mercury, the protoxide of cobalt, the protoxide and deutoxide of copper, the deutoxide of tin, the protoxide of nickel, the deutoxides of gold and platina, the oxides of tellurium and zinc. These combinations are *ammoniurets*. (See this word.)

Ammonia possesses in a high degree the alkaline properties of potash and soda, combining with all the acids, and forming salts which may be decomposed by heat. Ammonia is employed in medicine, and in chemistry as a re-agent. In order to obtain it, a mixture of equal parts of muriate of ammonia and lime, moistened with a small quantity of water is introduced into a retort, which is fitted to several flasks of Woulfe's apparatus. The retort is at first heated moderately; ammoniacal gas being disengaged, it is washed in the water of the first flask, and is dissolved in the others which must be kept at a low temperature, that the water which they contain may be saturated. The heating of the tube which connects the first two flasks, owing to the disengaged vapour of water, indicates that the operation is completed. It sometimes happens that ammonia contains pyro-empyreumatic oil, because that the muriate of ammonia, being made from animal substances, often retains a small quantity of this oil. Its existence in ammonia may be tested, by pouring into it sulphuric acid, which at first forms the sulphate of ammonia, but which being in excess, chars the oil, and colours the liquor. Ammonia may be impure, from its retaining a little muriatic acid. This may easily be known, by saturating the liquid with nitric acid, and then pouring into it the nitrate of silver, which, in case of the presence of muriatic (hydro-chloric) acid, forms an insoluble compound with the chlorine of that substance.

Ammonium. A name proposed by Davy and adopted by Berzelius, in order to designate the metal, supposed to be the radical of ammonia, of which metal oxygen and hydrogen may be considered as the oxides.

Ammoniurets. (*Ammoniures.*) These are combinations of metallic oxides, and in some cases perhaps of metals, of ammonia. Those combinations were noticed under the article liquid ammonia, but all have not been obtained in a solid state, for if the liquid ammonia in which the metallic oxides are dissolved, is evaporated, the oxides are precipitated in proportion as the ammonia is disengaged in the form of gas. The ammoniurets of mercury, antimony, platina, silver, arsenic, and copper, have however been obtained. Except the last two they are detonating, and appear to resemble in their properties the cyanates, or fulminates, which have been recently investigated by Gay-Lussac and Liebig; their preparation requires great precaution, and should be attempted only in small quantities.

Analysis. (*Analyse.*) It is the art of decomposing bodies in order to learn the nature and proportions of their constituents. In order to treat this subject extensively, it would be necessary to examine a great variety of chemical compounds, and to cite many examples. Not being able to go into a detail of particular cases we shall confine ourselves to those which are common to all species of analysis; referring those who would wish fully to investigate the subject, to the fifth volume of the Treatise on Chemistry, by M. Thenard. Believing that no one has developed the principles of this science more clearly and methodically than this celebrated chemist, we shall borrow from him the short exposition of analysis which our limits will permit us to give.

When a solid body is submitted to analysis it must first be minutely subdivided. This operation should be performed in mortars of porphyry, or by means of a file of a hardness greater than that of the substance to be divided, without which precaution the file itself would be operated upon; where this happens to be the case, it is necessary to determine by a preliminary experiment, the quantity of matter taken from the instrument, and to keep a memorandum of it. After having properly divided the substance to be analyzed, a certain quantity should be weighed, (say 14 grains,) in doing this the most delicate scales should be used. The substance being weighed, it should be brought in contact with the agents which are to effect its total or partial solution; after which, different re-agents should be poured into the solution, in order to precipitate successively, as much as possible, the substances existing in it. It is always necessary to pour in an excess of the precipitant, except it would dissolve the sensible qualities of the precipitates. For example, in order to extract the deutoxide of copper from the solution of the deuto-sulphate of this metal, we add more of the solution of potash than is necessary to saturate the acid; if it were not thus, a part of the acid would be united to the oxide, and then the precipitate, instead of being a pure oxide, would be a sub-sulphate, or a mixture of the oxide and sub-sulphate. The precipitate, whatever it may be, should be washed until all impurities are taken away. The washing should be made by decanting, or by means of a syphon, or small tube, and sometimes by filtration. In all these cases it may be known that the precipitate is cleansed when the waters of the washing no longer contain any foreign matter. For example, if sulphuric acid be poured into a solution of the nitrate of barytes in order to separate this base, it is necessary to wash the insoluble sulphate which is formed, but at the time when the waters of the washing will no longer be affected by the nitrate of barytes. In all cases, the different waters of the washing must be united as long as there remain in solution any traces of the matter subjected to analysis. The precipitate being washed, the next step is to dry it, first by placing it over an alcohol lamp; then when it is brought to a state of powder, if it can resist a high temperature, to heat it to redness in a crucible; after which it should be weighed. If, however, a high temperature would cause its decomposition, the precipitate should be submitted to the temperature of boiling water, and shaken occasionally, or placed in a vacuum upon hot sand, by the side of a capsule containing fragments of the chloride of calcium. The operations in analysis vary in different circumstances.

1st. Suppose that the precipitate has been separated by decantation, and that it can be heated to redness without decomposition; it should be put immediately into the

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crucible where the calcination is to be made. This crucible should be of platina or silver, and weighed before and after calcination, the difference of the weight will give the quantity of the precipitate. But if the precipitate cannot support so high a temperature without a change of state, and if, of course, it must be dried by some of the other means described, it may be more convenient to put it into a small capsule of porcelain, which must be (as in case of the crucible) weighed before and after drying the precipitate.

2d. Suppose the precipitate has been collected from a filter, if the substance can support a red heat, and the materials of the filter would have no effect upon it, the whole should be put into a crucible; the filter will be consumed, leaving the precipitate. In case the precipitate cannot resist the action of red heat it must be dried upon the filter itself, which is extended upon folds of paper; deducting from the whole weight that of the filter; this is done by taking a filter of the same size, drying it well, and weighing it.

3d. When the precipitate would support a red heat, but would be affected by the principles of the filter, this should be spread upon folds of paper, and the precipitate be carefully removed from it to the under fold of the paper, by a horn or ivory knife; or rather after having folded the filter upon itself, the water of the upper fold may be absorbed by applying to it two folds of bibulous paper, which should be pressed upon it lightly; by this means the matter upon the upper fold will adhere so closely to the lower fold, that the former may be removed without any of the matter adhering. Afterwards with the lower fold the same process may be gone through as with the filter, that is, to fold it, &c., as above described, and the precipitate will soon be obtained in a detached mass. It should then be calcined to a red heat; with regard to what remains on the filter, the quantity may be known by the method above described.

It often happens in the course of analysis, that it is necessary to evaporate certain solutions to dryness. While there is much of the liquid, the evaporation is made without any loss of the substance analyzed; but when it begins to thicken, there is some danger if the heat is very great, that it may be thrown out of the vessel and scattered about in various directions. This accident may be prevented by stirring the substance with a spatula, and gradually diminishing the heat.

If the body to be analyzed is a liquid instead of a solid, the same operations will be necessary, except the first, or process of pulverizing. In the analysis of the gases, there are some points of resemblance to the methods above described; but there are parts in this operation peculiar to itself. As in this kind of analysis, the weight of substances is estimated by their volume, their specific gravity being known, it is necessary to observe the pressure to which they are submitted, their temperature, and even when they are in contact with water, their hygrometrical state.

Antimony.* A metal of a bluish white colour, shining, gradually tarnishing by exposure to the air, of a lamellar texture, brittle, giving off an odour on being rubbed; its density is 6·702. It melts below red heat; and when suffered to cool slowly, it often presents upon its surface marks of crystallization, which have been compared to fern leaves, and which are the indications of a cleavage parallel to the faces of a regular octodron, which is the primitive form of this metal. It is not volatile, and has no action upon air and oxygen. It scarcely oxidizes in humid gases; but at a certain temperature it absorbs oxygen, and, eliminating caloric and light, passes to the state of a deutoxide. It combines with phosphorus, iodine, sulphur, selenium, and chlorine. When pulverized antimony is thrown into a flask containing chlorine, the combination gives rise to a disengagement of caloric and light. With other metals antimony forms a great number of alloys. Sulphuric acid does not oxidize it without the aid of heat. Concentrated nitric acid oxidizes without dissolving it, eliminating the deutoxide of nitrogen, and forming the nitrate of ammonia; the metal then passes to the second degree of oxidation. When the nitric acid is weak, it only transforms the metal into the protoxide, and dissolves it. Muriatic acid also dissolves it. The weight of its atom is 5·625.

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* Supposed to be derived from *anti*, against, and *monakos*, a monk. The injudicious use of it by Basil Valentine having, as is said, occasioned the death of many of the fraternity of the monks.

Antimony is found in nature, in the state of an oxide, a sulphuret, and a hydrated sulphuret. It is extracted from the sulphuret, which is very abundant in France. As this sulphuret is sufficiently fusible, the ore is heated in a large crucible, with an aperture at the bottom; this crucible rests upon another, which is to receive the sulphuret as it melts. Sometimes the ore is heated in a reverberatory furnace with the bottom inclined; and as the metallic matter separates from its dross, it runs into a vessel prepared for its reception. In some cases the sulphuret is slowly roasted, the oxidated matter resulting from this process being mixed with the nitrate and the acid tartrate of potash, and heated in a crucible; the metallic antimony takes the lowest place. The uses of this substance in the arts are not numerous; it is more frequently employed for preparations in pharmacy.

Antimoniates. Antimonites. Berzelius has thus named the deutoxide and tritoxide of antimony with salifiable bases, combinations which are not soluble except their bases are so. Gay-Lussac considers these compounds as simple mixtures of oxide; and he supposes that the combustion which takes place among many o them when they are exposed to a high temperature, is owing to the commencement of a combination, and not to a very intimate combination, as the Swedish chemist imagines. Most of the acids decompose these substances; those which are soluble, that is, those of potash, soda, and ammonia, are obtained directly, and the others by double decomposition.

ANTIMONY CRUDE. (*Antimoine Cru.*) *The sulphuret of antimony.*

ANTIMONY DIAPHORETIC. It is a compound of the peroxide of antimony and potash, which is obtained by throwing into a crucible heated to redness, in small quantities, 1 part of pulverized antimony and 2 parts of the nitrate of potash; a white mass is obtained, containing an excess of alkali; this is pulverized, and usually diluted in water, which dissolves the potash that is in excess, and which always takes with it a certain quantity of the oxide of antimony. The residuum is the *diaphoretic antimony*, washed. The waters of the washing, treated by nitric acid, deposite the white oxide of antimony, which the ancients called *pearlated matter of Kerkringine.* The product, which is obtained by placing in a vessel of cast iron a mixture of 3 parts of the nitrate of potash and 1 part of the sulphuret of antimony, and heating it with charcoal, is called the *Rotrou's melting.* It is a mixture of potash, of the sulphate of potash, and the oxide of antimony. These different preparations are employed in medicine.

APPARATUS. (*Appareil.*) A name given in chemistry to a series of vessels adapted to any particular operation. There is of course a great variety in the kinds of apparatus used; and in treating of the preparations of a compound, we usually describe the apparatus which is best adapted for the purpose. We shall here only remark upon *Woulfe's apparatus.* It consists of a series of 2, 3, 4, and 5 bottles, which communicate with each other by tubes, either with or without a bulb; but in the latter case, care must be taken to place at one of the tubulures of each flask a strait tube of safety, to prevent absorption. These bottles are usually adapted to a retort or matrass. From the last bottle proceeds a bent tube, the end of which is placed under water. These bottles always contain a liquid, and through this the gas which is not dissolved in the first passes on to the second, and so on through the whole.

Arcanum Corallinum. A name given by the ancients to the deutoxide of mercury upon which alcohol had been burned.

Arcanum Duplicatum. One of the ancient names for the sulphate of potash.

Arseniates. When submitted to the action of fire, all, except those of potash and soda, are decomposed; if the metal which it contains has little affinity for oxygen, the arseniate is changed into the deutoxide of arsenic and a metal; if the metal can pass to a higher degree of oxidation, the same phenomena appear, but the deutoxide of arsenic volatilizes; as an example of the first case, we may notice the arseniate of silver; of the second case, the arseniate of the protoxide of iron is an instance. Most simple bodies can decompose the arseniates at a temperature which varies in each of them. Water dissolves the arseniates of potash, soda, and ammonia. Sulphuric acid decomposes them at a moderate temperature; but at a high degree of temperature, arsenic acid decomposes the sulphate.

Various precipitates are formed with the arseniates:

1st. The solutions of arseniates precipitate the salts of cobalt rose-coloured; the precipitate formed of arsenic acid and the oxide of cobalt, dissolving in an excess of acid, should not be made in a very acid solution of cobalt.

2d. The arseniates in solution are not precipitated by muriatic acid; while the compounds of the white oxide of arsenic and an alkali are precipitated white by this acid.

3d. The nitrate of silver produces in the solutions of arseniates a brick-red precipitate, composed of oxide of silver and arsenic acid.

4th. The salts of copper precipitate a bluish white from the arseniate of copper.

5th. It is sufficient to leave the arseniates, during twelve or fifteen hours, in contact with sulphuric acid and some drops of another acid, in order to decompose them, and to precipitate a yellow sulphuret of arsenic. (*M. Orfila. Traité de Chimie, t.* 1 *p.* 553.)

In the neutral arseniates, the quantity of the oxygen of the oxide is to the quantity of the oxygen of the acid as 1 to 7·204. There are also sub-arseniates and acid arseniates. These salts being almost useless, we will only describe that of potash, with which all the others may be prepared by double decomposition.

ARSENIATE OF POTASH. (*With excess of acid.*) This salt may be crystallized in four-sided prisms; it is very soluble in water; with a high heat, it first melts, then becomes a neutral arseniate. This, and also the arseniate of soda and ammonia, may be prepared by a direct process; but it is better to heat to redness, in a crucible, a mixture of equal parts of nitrate of potash and of the deutoxide of arsenic. What remains in the crucible is then dissolved in water, and the arseniate is obtained by evaporating the liquor.

ARSENIC. (Supposed to be derived from an Arabic term *Arsanek*, signifying strong and deadly qualities.) Under this name is known the metal arsenic, and white arsenic, or the deutoxide of arsenic, which on account of its solubility, and its corrosive action upon the animal economy, is rightly considered as a most deadly poison. We shall here describe only arsenic, properly so called, referring for the consideration of *white arsenic*, to the article *oxide of arsenic* (*deuto.*) Arsenic is a metal of a steel gray colour, and a shining fracture; its texture is granular and scaly; its hardness is not very great, and it is very fragile. Its specific gravity is 8·308. If exposed to the action of heat in close vessels, it sublimes and crystallizes in tetrahedrons. If exposed to the air, particularly to damp air, it soon loses its brilliancy, and is covered with a blackish substance, which appears to be the protoxide of this metal.

If small quantities of arsenic are thrown upon burning coals, it immediately absorbs the oxygen of the atmosphere, volatilizes in the form of white vapours, having a strong smell of garlic; this is the deutoxide of arsenic. It unites to hydrogen, sulphur, chlorine, iodine, and selenium, and also forms a great number of alloys, to which it communicates its fragility. Nitric acid with heat oxidizes it, and can even cause it to pass into the state of an acid; although when pulverized in the metallic state, arsenic acts upon a solution of the sulphate of copper, and forms a certain quantity of insoluble arsenite of copper. Arsenic is frequently found in nature in the state of an alloy, sometimes sulphuretted, oxidated, and even in the state of an arseniate. Powdered arsenic is employed for destroying rats.* Arsenic is obtained by roasting the ores of cobalt, which often contain it in considerable quantities; as it is very volatile, it vaporizes and condenses in receivers prepared for that purpose. The greater part passes over in the state of a deutoxide, but a certain quantity in a metallic state is also obtained by sublimation; in order to obtain it very pure, the metal is collected and sublimed in a cast iron retort.

Arsenic, White. See *Oxide of Arsenic* (*Deuto.*)

Arsenites. These are combinations of the arsenious acid, or the deutoxide of arsenic with salifiable bases; these compounds strongly resemble arseniates; they, however, may be distinguished by precipitating the solution of the sulphate of copper green, while the arseniates precipitate it a bluish white. The arseniates, if exposed to the action of fire in close vessels, decompose; the arsenious acid volatilizes, or rather one part decomposing, yields oxygen to the other, which passes to the state of arsenic acid, and one portion of metallic arsenic volatilizes. This last circumstance does not take place except when the base has a strong affinity for arsenic acid. All the arsenites, except those of potash and soda, are insoluble in water; all are decomposed by a great number of acids. Those which are soluble are obtained by a direct process; those which are insoluble are prepared by double decomposition. In the neutral arsenites the quantity of the oxygen of the oxide is to the quantity of the oxygen of the acid as 2 to 3. The arsenite of copper is employed in the arts as a green colour, and known under the name of *Scheele's green.* It is obtained by decomposing the sulphate of copper by the arseniate of potash.

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* Hence its common name, *rats' bane.*

Arseniuretted Hydrogen. A colourless fluid, possessing the odour of garlic; highly destructive to animal life. It is best prepared by digesting an alloy of tin and arsenic in muriatic acid. This gas was discovered by Scheele.

Ashes. (*Cendres.*) The fixed residue of combustible substances, which remains after they have been burned. In chemistry it is commonly used to denote the residue of vegetable combustion.

Asparagin. A vegetable substance, colourless, of a nauseous taste, capable of crystallization in rhomboidal prisms. Submitted to the action of fire, it swells and gives a charcoal which can burn without any residue. It is slightly soluble in water. This solution does not affect vegetable colours; is not changed by the infusion of nutgalls, by the acetate of lead, the oxalate of ammonia, the muriate of barytes, or the hydro-sulphuret of potash. It is insoluble in alcohol. Its discovery is due to Vauquelin and Robiquet. These chemists obtained it by heating the juice of asparagus in order to coagulate the albumen, filtering and evaporating it; and then leaving the liquor to stand for fifteen or twenty days, during which time it forms rhomboidal, hard, and brittle crystals, which are the asparagin; also acicular crystals, which appear to be *mannite;* these should be carefully separated from the first, which should be crystallized anew.

Asphaltum. See *Bitumen and Coal Mineral.*

Assay or Essay. This operation consists in determining the quantity of valuable or precious metal contained in any mineral or metallic mixture, by analyzing a small part thereof. The practical difference between the analysis and the assay of an ore consists in this: the analysis, if properly made, determines the nature and quantities of all the parts of the compound; whereas the object of the assay consists in ascertaining how much of the particular metal in question may be contained in a certain determinate quantity of the material under examination. Thus, in the assay of gold or silver, the baser metals are considered as of no value or consequence; and the problem to be resolved is simply, how much of each is contained in the ingot or piece of metal intended to be assayed.

Astringent Principle. The effect called astringency, considered as distinguishable by the taste, is incapable of being defined; we can only refer to substances which by their taste exhibit the astringent principle, as the husks of walnuts, green tea, and particularly nutgalls. (See *Tannin.*)

Atmosphere. See *Air Atmospheric.*

Atom and Atomistic Systems. It is supposed that bodies are formed of infinitely small particles called *atoms.* Now it is known that all chemical combinations are submitted to general laws for the proportions of the elements which constitute them, and that every compound results from the juxtaposition of a certain number of atoms. It appears, according to Berzelius and Dalton. to whom more particularly we are indebted for a knowledge of these laws, that one atom of an element can unite with 1, 2, 3, or a greater number of atoms of another element. In the inorganic kingdom it has not yet been discovered that one atom of a body combines with more than 6 atoms of another body. These unions of elementary atoms give rise to compound binary atoms, which by their combination produce still more complicated results, but which can always be traced to general laws. The quantity of water which the compounds often contain, renders their laws of combination still more complex. Thus, 2 atoms of a body may combine with 3 atoms of another, or 3 may combine with 4, but the combinations of these compound atoms also follow a general law. When two binary oxygenated compounds unite, which often happens in chemical operations and in natural combinations, they unite in such proportions, that the quantity of the oxygen of the one is always a multiple by 1, 2, 3, and more, of the quantity of the oxygen of the other. For example, in any substance whatever the quantity of the oxygen of the oxide is to the quantity of the oxygen of the acid in the following proportions.

In the combination of compound atoms, ternary or quarternary, it is found that the oxygen of one of the oxides is a multiple or sub-multiple, by a whole number of the oxygen of each of the other oxides; this is observed in many minerals. Berzelius thinks that one atom cannot combine with more than twelve atoms, because that a sphere cannot be touched by more than twelve spheres of the same size; but as has already been remarked, there are few compounds whose atoms arunited in this proportion. In the carburet of iron, however, this number is much exceeded, and organic compounds exhibit many anomalies.

Berzelius takes for unity, the weight of an atom of oxygen, which he called 100; he then subtracts the relative weight of the atoms of different bodies, and expresses them with reference to this unity. In sulphur, for example, he found the weight of its atom, in the following manner: "When a sulphurretted metal oxidizes and forms a neutral salt, the sulphur, in order to compose the sulphite, requires twice as much, and for the sulphate three times as much oxygen as the metal to form the oxide. If then the metal takes one atom, the sulphur takes 2 or 3 to form the sulphite or the sulphate, and if the metal in the oxide took as many particles of oxygen as it before contained particles of sulphur, sulphuric acid would be composed of 1 atom of sulphur and 3 atoms of oxygen. This, with a very few exceptions, is found to be the degree of sulphuration which takes place, compared with the degree of oxidation which a metal is most apt to form, giving the same relation between the weights of the sulphur and oxygen as that which results from the analysis of sulphuric acid, if we regard it as composed of 1 atom of sulphur, and 3 atoms of oxygen. For example; 100 parts of silver combine with 7·3986 of oxygen, and with 14·9 parts of sulphur; but if these were so many atoms, the weight of the atom of sulphur would be to that of the atom of oxygen, as 100 to 201·16. 100 parts of lead take 7·725 of oxygen and give 146·44 of the sulphate of lead, or the oxygen, of the acid is the triple of that of the oxide of lead; it follows that the sulphuric acid which is formed, is composed of 23·175 of oxygen and 15·54 of sulphur; but if these parts of oxygen contain 3 atoms, and those of sulphur contain but 1 atom of sulphur, it follows, that $\frac{23\cdot175}{3}$: 15·54 :: 100 : 201·65. The particle of sulphur then weighs 201·65;

Sulphuric acid is formed of 1 atom of sulphur and 3 atoms of oxygen, and sulphurous acid is formed of 1 atom of sulphur and 2 atoms of oxygen."—(*Berzelius.*)

Dalton takes for unity in the weight of atoms, the weight of hydrogen, because this substance has the least specific gravity of all others known, and of course combines in the smallest proportions. Berzelius and others prefer oxygen, as being the substance most common in combinations. Berzelius states its atom as weighing 100; others (which in fact amounts to the same) state it as weighing 1. It is very easy to ascertain the weight of the atom of any substance relatively to either of these numbers. It is only necessary to divide or multiply this weight by 100.

Atropine. A name given by Brandt to a peculiar substance which he extracted from the *Atropa belladona*, and to which he attributes alkaline properties. It is obtained by saturating the infusion of the plant with magnesia, and heating the precipitate with alcohol. On cooling, the atropine is deposited in the form of brilliant needles, translucent, insoluble in cold water, a little soluble in warm water, and scarcely soluble in ether. It forms with acids crystallizable salts. When these solutions are evaporated, they diffuse through the air vapours which cause a dilatation of the pupil of the eye.

Attraction. This is the basis of all *physical phenomena;* or it is that action which bodies at a distance exert upon each other, according to laws derived from their size and distance, and the peculiar nature of their substances. It is also the basis of all *chemical phenomena,* or the action by which bodies placed in contact, act upon each other by affinity. In the first instance, this force has received the name of *planetary attraction*; it is this which retains the heavenly bodies in their orbits, which by a combination of forces, prevents their irregular movement, and which, in a word, maintains the harmony of the universe. In the second instance, attraction does not act at a distance, but only at the point of contact, or when the molecules (see this word) touch each other, and it then receives the name of *molecular attraction.*

Since the molecular attraction is all that can take place in the bodies which cover the surface of the earth, since it is this which occasions all chemical combinations, it will be this kind only that we shall here consider. When the molecular attraction takes place between particles of the same nature, it is called *cohesion.* Thus the force which prevents the molecules of sulphur or iron from flying off from their state of union with the other molecules, is called cohesion; but that force which unites iron to sulphur, or which retains the molecules of sulphur in connection with those of iron, is *affinity,* or that tendency by which the molecules of one substance combine with those of another substance. These two forces cohesion and affinity are often opposed to each other; thus, when two bodies are solid, they can seldom be made to combine chemically; if one is liquid, the cohesion of the other may present an obstacle to their combination; but if both are liquid, they will unite unless their affinity be very feeble. When the affinity is feeble, the compound which results partakes of the properties of the two substances from which it is formed; but if the affinity is very strong, the new substance possesses properties which are very different from those of the constituent principles. The combination is also promoted by the cohesion which is produced. As for example, if into a solution of the nitrate of barytes, should be poured some drops of sulphuric acid, immediately will be formed an insoluble and very dense compound, which probably would not have been formed so readily if the density had been less.

Affinity may be modified by different causes; the most powerful of all is the electrical states of substances; it has even been maintained, that affinity is only a modification of electricity, and wholly the result of the electrical states of different bodies. It is supposed that a body positively electrified, combines with a body negatively electrified; and that in every binary compound, there exists an *electro-positive element*, and an *electro-negative element*; that the electro-negative substance can become electro-positive in relation to another body, and so reciprocally. It follows from this hypothesis, that two substances will combine much more strongly, when they are both strongly electrified, the one positively, and the other negatively.

Caloric is also one of the forces which modify affinity, as it can interpose between the molecules of bodies, and keep them at different distances; a great number of combinations are effected by its assistance, which, without it, would be vainly attempted. But if between the molecules of a substance, caloric is interposed in such a quantity that the molecules of this substance are found a certain distance from each other, (this distance is called their *sphere* of *attraction*,) it follows, that these molecules separate, and the attraction of affinity is destroyed; this is the case in distillation, the roasting of minerals, &c. This caloric favours the combination of solid, but not volatile substances; on the contrary, it is unfavourable to the combination of gaseous substances, whose molecules are already comparatively distant. Pressure has an opposite effect to that of caloric, since its tendency is to bring together the molecules of bodies; it is injurious to the combination of solid bodies, and favourable to that of gases: this is demonstrated by experience.

The relative quantity of the bodies which are to be combined has much influence upon affinity. As bodies combine ordinarily with each other in the relation of 1 of the one body with 1, 2, 3, or more of the other, if to a given weight of a body represented by 1, is presented the weight of another body represented by 1, the combination will be more easily effected than if to this body was presented the weight of another body represented by 2, 3, or a greater number; and if we should attempt to decompose a compound of 1 of the one body, and 3 of the other, it would be seen that this compound would easily leave 1 part of the substance which contains 3; less easily 1 part from the substance which contains 2, and with difficulty would leave the last portion of the body which combined with it; thus the affinity of one body for another, is in an inverse proportion to the quantity of the other body. The density of bodies, as has been already observed in remarking upon cohesion, presents an obstacle to their union; but this may be modified by caloric and pressure. There are few substances in which the chemist has not been able to overcome the resistance of affinity; the means of doing this are various, and often very complicated; many forces may be made to act upon a substance which seldom effectually resists when the decomposing forces are judiciously employed. *All the processes which may be resorted to in the treatment of different substances can only be known by a knowledge of the action which bodies exercise upon each other, of the phenomena which accompany this action, and of the compounds which result from it; it is this knowledge which constitutes Chemistry.*

Aurate. A name proposed by Pelletier, for the combinations of auric acid with alkalies.

Aurum Musivum. The proto-muriate of tin.

Azote. From the Greek *a* without, and *zoe* life, signifying to deprive of life. See *Nitrogen.*

Azote Carbonated. See *Cyanogen.*

Azote Oxymuriated. See *Chloride of Nitrogen.*

Azotures. A name given to combinations of azote (nitrogen) with different combustible bodies; these are cribed under the articles, *Ammonia*, *Chlorine*, *Cyano-*

gen, and *Iodide of Nitrogen*. Gay-Lussac and Thenard in their brilliant experiments upon metals, obtained *ammoniacal* azotures of potassium and sodium; they perceived that by fusing these two metals in ammoniacal gas, an action took place, giving rise to a very fusible olive green substance, formed of potassium, or sodium, of azote and ammonia, and one volume of hydrogen, exactly equal to that which gives with water the quantity of potassium employed. If this green substance is exposed to heat, it first melts, then decomposes, and is converted into an azoture of potassium or sodium. It absorbs moisture from the air, changing itself into ammoniacal gas and potash, or soda; it decomposes water instantly, with a disengagement of light. The acids decompose it, forming a base of ammonia and potash or soda. It decomposes in alcohol, and may be preserved in the oil of naphtha. (*Recherches physico-chimiques de MM. Gay-Lussac et Thenard.*)

Azoture of Carbon. See *Cyanogen.*

Azoture of Chlorine. See *Chloride of Nitrogen.*

Azure. A name given to glass, coloured blue by the oxide of cobalt. This glass in a melted state is poured into water, and afterwards pounded; the powder is mixed with water, and after a short time decanted. The azure, which is last deposited, is the most brilliant.

B.

Balance. The beginning and end of every exact chemical process consists in weighing. With imperfect instruments this operation will be tedious and inaccurate; but with a good balance the results will be satisfactory; and much time, which is so precious in experimental researches, will be saved.

The balance is a lever, the axis of motion of which, is formed with an edge, like that of a knife, and the two dishes at its extremities are hung upon edges of the same kind. These edges are first made sharp, and then rounded with a fine hone, or piece of buff leather. The excellence of the instrument depends, in a great measure, on the regular form of this rounded part. When the lever is considered as a mere line, the two outer edges are called points of suspension, and the inner the fulcrum. The points of suspension are supposed to be at equal distances from the fulcrum, and to be pressed with equal weights when loaded.

Balloon. (*Ballon*, or *balon*.) A large glass receiver in the form of a hollow globe. For certain chemical operations *balloons* are made with two necks, placed opposite to each other ; one to receive the neck of the retort, and the other to enter the neck of a second *balloon :* this apparatus is called *enfiladed balloons.* Their use is to increase the whole space of the receiver, because any number of these may be adjusted to each other. The only one of these vessels which is generally used, is a small oblong *balloon* with two necks, which is to be luted to the retort, and to the receiver, or great *balloon;* it serves to remove this receiver from the body of the furnace, and to hinder it from being too much heated. The term balloon is also applied to a spherical bag filled with a gas of small specific gravity, by the buoyancy of which it is raised into the atmosphere.

Balsam. (*Baume.*) The term balsam was anciently applied to any strong scented natural vegetable resin, inflammable, not miscible with water, and supposed to be possessed of many medical virtues. All the turpentines, the Peruvian and copaiva balsam, &c., are examples of natural balsams. Besides, many medicines compounded of various resins, or oils, obtained the name of balsam. Chemists now restrict this term to vegetable juices, consisting of a substance of a resinous nature, capable of affording benzoic acid. They are insoluble in water, but readily disssolve in alcohol and ether. The liquid balsams are Copaiva, Opo-balsam, Peru, Styrax, Tolu; the concrete are Benzoin, Dragon's blood, and Storax.

Barium. This metal is hardly known. In nature its oxide is found combined with sulphuric and carbonic acids. This is heavier than water, of a dark gray colour; it readily attracts oxygen from the atmosphere, and passes to the state of an oxide. (See *Calcium.*)

Barytes. See *oxide of Barium.*

Bases Salifiable. All such substances as uniting to acids form salts: as ammonia, and the different metallic oxides.

Bases. Vegetable Salifiable. See *Vegetable Alkalies.*

Bassorine. This substance was first extracted from the gum of Bassora. Pelletier has since discovered it in the assafœtida, and Braconnot in St. Ignatius' bean, and some other substances. It has some resemblance in its properties to gum adraganth, particularly in swelling in either cold or boiling water. It easily dissolves in water containing a little nitric acid. Treated with potash it disengages ammonia. It is very easily obtained by treating gum Bassora with water, alcohol, and ether. As it does not dissolve in any of these liquids the residue contains only some vegetable remains, which are easily separated by continued washings. (*Vauquelin.*)

Bell-Glass. (*Cloche.*) A hollow, cylindrical article of glass or crystal, open at its base, round and closed at the top, which is terminated by a stopper. Some bell-glasses, instead of the glass stopper, have a stop cock of copper; others, one graduated into a certain number of equal degrees. Bell-glasses are of great use in chemistry, either to collect gas, to transfer, or to measure it,

Benzoates. Combinations of benzoic acid with salifiable bases. These salts are all easily decomposable by caloric; those of the metals of the first two sections* are soluble and crystallizable, those of zinc and iron the most so. The others are insoluble. In the benzoates, according to Berzelius, the oxygen of the base is to the acid as 1 to 15·098. All these salts are without use, and very little studied.

Bezoard Mineral. It was by this name that the oxide of antimony was formerly known, when precipitated from its solutions.

Bi (From *bis*, twice.) In composition it signifies twice or double.

Bi-Arseniates. See *Arseniates.*

Bi-Phosphates. See *Phosphates.*

Bi-Seleniates. See *Seleniates.*

Bi-Sulphates. See *Acid Sulphates.*

Bile. A bitter liquid, more or less viscous, of a greenish yellow, heavier than water, found in most animals. Bile submitted to distillation, gives a volatile colourless product, of a nauseous smell, precipitating by the acetate of lead. The dried residue forms nearly one eighth of the bile which was employed: it is slightly deliquescent, and almost entirely soluble in water and alcohol, decomposes at a high heat, gives the same products as all animal substances; these contain many salts, particularly soda. Eight hundred parts of the bile of the ox, according to Thenard, consists of water, 700

Resinous matter,	15
Picromel,	69
Of a yellow matter,	4
Soda,	4
Phosphate of soda,	2
Chlorides of sodium, and of potassium,	3·5
Sulphate of soda,	0·8
Phosphate of lime,	1·2

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* See *Metals*, Thenard's sections.

and some marks of oxide of iron. The bile of man differs little from these proportions, but contains more pioromel.

Bismuth. A metal of a yellowish white colour, very brittle, of a lamellar structure, crystallizes in cubes; its specific gravity is 9·822, it fuses at 256°; it tarnishes in damp air; burns at a very high temperature, with a disengagement of light. It unites with most of the metals, as phosphorus, sulphur, selenium, chlorine, and iodine. This metal seems not to have been known very anciently, though Agricola, in 1520, pointed out the means of obtaining it; it was formerly called *glazed tin*. In nature it is found in the state of an oxide, and combined with sulphur and various metals. It is not common, is easily extracted by introducing the mineral containing it into iron cylinders placed across a furnace; one of the extremities is entirely closed; the other, through which the metal flows, is partly closed by a luting of clay. When heated, the bismuth melts and flows into iron crucibles; it must then be submitted to a high heat, in order to exclude the arsenic. Its purity is ascertained by treating it with nitric acid; it will dissolve entirely if pure, otherwise the arseniate of bismuth is deposited.

A preparation of bismuth known by the name of pearl powder, or pearl white, is sometimes used as a cosmetic, though its effect upon the skin is injurious; it is liable to be turned black by sulphuretted hydrogen gas.

Bitumen. The bitumens are substances either solid or liquid, emitting an odour more or less strong. They burn, leaving a residue, which is easily incinerated. Liquid bitumen, or *naphtha*, is transparent, of a yellowish white colour, almost without taste; it burns like essences upon the approach of an ignited substance, with a bright but sooty flame. There are many varieties, which differ both in their consistence and their colour as more or less deep. Naphtha is found on the borders of the Caspian sea, in Calabria, in Sicily, and various other parts of the world, and is procured by distillation from petroleum. It is sometimes used instead of candles.

Bitumen Solid, or Asphaltum. It is black, shining, friable, insoluble in alcohol, acquires an odour by rubbing, and burns with facility. It is usually found on the surface of lake Asphaltites; this has given rise to its name. According to historians, it was this bitumen, which was used as a cement for the walls of Babylon. Naphtha, or liquid bitumen, is, according to the experiments of Saussure, composed of hydrogen, 87·60, and carbon, 12·78. It is employed to preserve potassium, sodium, barium, &c.

Black Lead. *See Plumbago.*

Blanc De Baleine. *See Spermaceti.*

Bleu D'Outre Mer. *See Ultramarine.*

Blood. This liquid is very abundant in most animals. Its colour in the arteries is a lively red, and a deep purple in the veins of animals containing red blood. Its taste is slightly salt, its specific gravity as found in man, is 10·527 at the temperature of 60°. Blood on standing for a short time separates into two portions; the one solid, called *crassamentum* and the other liquid, which is called *serum*. If exposed to a temperature of 100°, it coagulates on account of the albumen which enters into its composition; alcohol also coagulates it; the different salts form with it a precipitate which results from the union of albumen with the oxide of the metal; the precipitate does not of course take place, when the oxide can form with the albumen a soluble combination. This is the case with the salts of potash, soda, and some others. Blood is also coagulated by chlorine, by sulphurous and muriatic acid gases. Venous blood in contact with oxygen, becomes red, as when it meets with air in the lungs. Potash and soda can also form soluble compounds with fibrine; they prevent blood from coagulating.

According to Berzelius, blood is composed of a great quantity of water, of albumen, fibrine, a coloured animal substance, a little oily matter, chloride of potassium and sodium, the sulphate of lime, sub-carbonates of lime, soda, and magnesia, of oxide of iron, and acetate of soda. This last substance has not been found by other chemists in the analysis of blood. The solid matter which is formed from blood, or the crassamentum, is composed of fibrine, colouring matter, an oily substance, and a certain quantity of water. The serum contains the rest of the water, with most of the salts and the albumen.

Blow Pipe. (*Chalumeau.*) A simple instrument, invented for the purpose of directing the flame of a lamp for the analysis of minerals and for other chemical purposes. It consists of a tube of silver, copper, or glass, about one eighth of an inch in diameter at one end, and the other tapering to a much less size, with a very small perforation. A blow pipe has been constructed by Professor Hare of Philadelphia, by which a stream of oxygen and hydrogen gas is conducted upon the ignited substance; this is called the *oxy-hydrogen blow pipe.*

Blue of Cobalt, or Thenard's Blue. (*Bleu de Thénard, ou de Cobalt.*) A substance of a beautiful blue, which is substituted for ultramarine in oil painting. This colour is prepared as follows: The ore of Swedish cobalt is first roasted in order to drive off the arsenic as much as possible; it is dissolved in diluted nitric acid; the solution is then evaporated almost to dryness, the residue heated with distilled water, and the liquor filtered in order to separate the arseniate of iron which is deposited; into the liquor is poured a solution of the sub-phosphate of soda, which forms a violet precipitate of the sub-phosphate of cobalt; this precipitate being washed, one part of it, in the form of a jelly, is mixed with 8 parts of alumine, also in a jelly. This mixture is dried upon plates by a stove; when brittle, it is gradually heated to redness in a crucible; this temperature is continued for half an hour; it is then left to cool. A result analogous to this is obtained by employing one half part of arseniate of cobalt, and 8 of alumine, or the same quantity of the nitrate of cobalt with alumine, or alum based upon ammonia. The arts are indebted for the discovery of this brilliant colour, to the learned Professor Thenard; he considers it as composed of the sub-phosphate of cobalt mixed with alumine.

Blue Prussian. A substance of a deep blue, much heavier than water, retaining it with tenacity. It experiences no alteration at a temperature of 135°. If submitted to distillation in a retort, at a very high heat, it gives off the hydro-cyanate of ammonia and the carbonate of the same base. Prussian blue burns easily, leaving a considerable residue of the oxide of iron. Chlorine changes it to green, but deoxygenating substances restore to it its primitive colour. Water and alcohol have no action upon it. Potash, soda, ammonia, barytes, strontian, chlorine, and magnesia, decompose it, forming a cyanite and a precipitate. The peroxide of iron and the deutoxide of mercury have the same effect. Weaker acids affect it but little. Many concentrated acids act upon it. According to M. Robiquet, sulphuric acid changes it white, without disengaging any gas, or becoming charged with any of its principles; if the acid is diluted with water, the colour re-appears.

The discovery of prussian blue is due to a colour-maker, named *Diesbach*, who prepared lake from cochineal, by mixing the decoction of this substance with alum and a little of the sulphate of iron, and then precipitating it by an alkali. Being at a certain time in want of potash, he borrowed from Dippel, in whose laboratory he was at work, some of the salts of tartar which had been used by that chemist in the distillation of animal oil. The lake precipitated by this alkali, instead of being red.

was of most beautiful blue. Dippel, to whom the phenomenon was made known, perceived that it was the effect of the salt of tartar, and endeavoured to produce the same effect by the agency of other alkalies, and the knowledge of the existence of prussian blue was thus completely established. The manner of preparing it was for a long time kept secret. In 1724, Woodward, in his "*Transactions Philosophiques*," described it. Many chemists, particularly Macquer, attempted to ascertain the nature of the substance; but it was reserved for Scheele to discover the acid which Bergman and Guyton had suspected. It was afterwards studied by Proust, Berthollet, Vauquelin, Robiquet, and Berzelius.

The following is the process made use of in the arts for obtaining Prussian blue: A mixture of equal parts of dried blood or horns, and the potash of commerce, is heated in a large iron crucible, until it becomes clammy; when cold, it is thrown into fifteen times its weight of water, and occasionally stirred; at the end of an hour, the liquor which contains the hydro-carbonate of potash, sub-carbonate of potash, and some other salts, is filtered. To this liquor is added 4 parts of alum, and 1 part of the sulphate of iron; this forms a very abundant precipitate, composed of alumine, the hydro-ferro-cyanite of iron, and a small quantity of the sulphate of iron. When the liquor ceases to be coloured by adding these salts, the operation is completed. The precipitate is washed with many waters, which are renewed once in 12 hours. It is at first brown, then greenish brown, next bluish brown, and from this shade it passes, by contact with the air, to a deeper hue. It is left to drain, and dried upon the strainers. The rationale of the phenomena presented by this operation, is thus given by M. Thenard: The animal matter is decomposed by calcination, disengaging water, carbonic acid, ammonia, oxide of carbon, oil, carburetted hydrogen gas; in a word, all the products of animal matter. The residue is composed of carbon, potash more or less carbonated, cyanide (*cyanure*) of potassium, sulphuret and chloride of potassium. When the residue is thrown into water, the carbonated potash, the cyanide, sulphuret, and the chloride of potassium, dissolve; the first remains inactive, and the three others decompose the water; from thence is formed the hydro-cyanate, instead of the cyanide, the hydro-sulphate, &c. Potash decomposes alum, uniting with its acid, and precipitating its base; it is the same with the sub-carbonate, and the sulphate of potash; the last two disengage carbonic acid, and sulphuretted hydrogen; the hydro-cyanate of potash forms with the proto-sulphate of iron, a white insoluble precipitate of hydro-ferro-cyanate of the protoxide of iron; this also contains the hydro-ferro-cyanate of potash. With the same sulphate of iron, the hydro-sulphate of potash forms a black precipitate of sulphuretted hydrogen, and protoxide of iron. The washings serve to dissolve the soluble salts which are foreign to the prussian blue, such as the sulphate of potash, &c. and particularly to bring the oxide of iron to the maximum (*the highest degree*) of oxidation, by means of the air contained in the water. Prussian blue is then a hydro-ferro-cyanate of potash and of iron, mixed with alumine; or, as may be expressed, a mixture of the cyanide of potash and iron with water and alumine.

Bone. (*Os.*) Bones are solid, tasteless, without odour, white, very hard and brittle in old people, more flexible in children. When submitted to distillation, they give all the products of animal matter: heated in the air they form *bone black*; if burned they become black; if the heat is continued they become white, light, and friable; if left to themselves they exfoliate, and in a few days fall to powder. If boiled, all the gelatine dissolves, and nothing but the earthy part remains. When bones ·e digested in weak chloric acid all the salts dissolve.

they are then flexible, elastic, and are composed wholly of animal matter. This substance washed in boiling water may be considered as pure gelatine. Bones vary greatly in their composition according to the age of the individuals, and the species of animals. Fourcroy and Vauquelin who analyzed human bones, found them composed of a large quantity of the phosphate of lime, a little of the phosphate of magnesia, phosphate of ammonia, oxides of iron and manganese, some traces of alumine and silex, gelatine, and water. MM. Proust and Hatchett have also ascertained the presence of the carbonate of lime. Berzelius thought he discovered fluoric acid, but this has been confirmed by no other chemist.

The following are the proportions of bone as given by Berzelius: gelatine 32·17, blood vessels 1·13, fluate of lime 2·00, phosphate of lime 11·30, phosphate of magnesia 1·10, water 1·20. Vogel, who analyzed the bones of a cemetery which had been closed for nearly 1100 years, found that they contained no more gelatine, but a much greater proportion of carbonate of lime than fresh bones. The bones of herbivorous animals, according to Fourcroy and Vauquelin, contain the same principles as human bones. Berzelius found the fluate of lime, and Mr. John the sulphate of lime in those of the ox. M. Chevreul who analyzed the bones of fossil marine animals, found in them the sulphate of lime united to a little animal matter 1½, water 10½, phosphate of lime iron and manganese 6·7, albumen 1, carbonate of lime 4, and some traces of the fluate of lime. M. Bouillon Lagrange found in analyzing the turquoise that it was composed of phosphate of lime 80, carbonate of lime 8, phosphate of iron 2, phosphate of magnesia 2, albumen 1½, water and clay 6½. The bones of fishes appear to be formed of a mucus similar to that of the nails and hair. Thenard has made a series of interesting experiments upon different parts susceptible of ossification (changing to bone). Teeth, in their composition, differ very little from bones. Berzelius and Morrichini assert that they contain some fluate of lime, but Fourcroy and Vauquelin, and several other chemists, assert that they have not been able to discover in teeth any traces of it. M. Lassaigne has made the following analyses of human teeth :

	SUBSTANCES ANALYSED.	animal matter.	phosphate of lime.	carbonate of lime.
100 parts.	Teeth of a man aged 81	33	66	1
	" " middle aged person	29	61	10
	" " child of 6 years	28·5	60	11·5
	" " child aged 2 years	17·5	65	17·5
	" " infant aged 1 day	35	51	14
	" " mummy of Egypt	29	55	15·5
	* Enamel of human teeth	20	72	8

Fourcroy and Vauquelin consider ivory as formed of the same principles as bones. Gay-Lussac and Morrichini have discovered in it some fluate of lime. It is with ivory calcined to a certain degree, thus the beautiful velvet-like colour called *ivory black* is prepared.

Borates Neutral. (*Borates Neutres.*)Combinations of boracic acid with bases in which the salts are neither acid nor much alkaline. These salts are little known ; Berzelius, however, has given the proportions of borate of barytes ; according to him it is formed of twice as much acid as the sub-borate of the same base.

Borates Sub. (*Borates Sous.*) Combinations of boracic acid with an excess of the base ; these salts are mostly insoluble, but those of ammonia, potash, and soda are soluble and crystallizable; all the sub-borates of the first four sections are undecomposable by fire, on account of the permanence of their acid ; but where the metals have not a strong affinity for oxygen, they may be decomposed ; the boracic acid being set free, the metal is reduced and oxygen disengaged. The sub-borate of ammonia whose base is volatile is easily decomposed, the ammonia set free, and the acid remains insulated. The sub-borates are decomposed by all soluble salts, which can form with boracic acid, insoluble salts, such as the chlorate of lime, the nitrates of strontian, of barytes, &c. Nature presents us the sub-borate of soda (borax) and the sub-borate of magnesia; the others are the products of art. In the sub-borates the quantity of the oxygen and of the oxide, is to the quantity of the acid, as 1 to 2·696.

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* Fourcroy and Vauquelin have found in the enamel of human teeth a little of the sulphate of iron.

Borate (Sub) of Ammonia. (*Borate sous d'Ammoniaque.*) This salt is the product of art; it is obtained by dissolving boracic acid in an excess of ammonia; the salt crystallizes on cooling. It greens the infusion of violets, and is decomposed by a red heat, giving off all its ammonia.

Borate (Sub) of Potash. (*Borate sous de Potasse.*) This salt is prepared directly by combining potash and boracic acid; it is little known.

Borate (Sub) of Soda, or Borax. (*Borate sous de Soude.*) This salt deeply greens the infusion of violets; it has an alkaline taste, dissolves in twice its weight of boiling water; but much more cold water is necessary to effect its solution. It crystallizes in hexahedral prisms with compressed summits; it has an opaline colour and a glassy fracture: exposed to fire, it loses its water of crystallization and is transformed into a substance called *glass of borax*, which soon tarnishes by attracting humidity from the atmosphere. M. Dobereiner ("*Annales de Chimie et Physique*") thinks that it is decomposed by charcoal at a high temperature. This salt is known in commerce by the name of *borax*, is found abundantly in nature, particularly in Tartary and China, Ceylon, and other places of Asia; and also exists in Peru, where it is found at the bottom of salt lakes. Much of the borax of commerce needs to be divested of an oily matter which seems to be united to the excess of the soda; this is called *tinckal*, or impure borax; that which comes from China is much more pure and easy to be refined. Robiquet and Marchand have published the process which they use in purifying it. They first put the impure borax into a tub, with water sufficient to cover it; after letting it stand half a day, they add one part of slaked lime to 400 of borax; the liquor remaining until the next day, a sort of calcareous soap is formed with the oily matter which is deposited. The salt is afterwards separated by means of sieves with large meshes; it is redissolved by heat, in twice and a half its weight of water; 1 part of the hydrochlorate (*oxymuriate*) of lime is then added for 50 of the borax. The liquor, filtered and concentrated to 20° of the aerometer, is turned into leaden cones, because this form is favourable to crystallization; it should cool slowly to obtain such crystals as are valuable in commerce.

This substance is also extensively manufactured by combining directly boracic acid from the lakes of Italy with the sub-carbonate of soda. It is sufficient to heat the acid with the soda, and concentrate the solution as above described. The borax thus obtained, though whiter than the other, is less valued. Borax is often used in the arts. It facilitates the vitrification of many oxides, and forms with them glass differently coloured.

Borax. See *Borate* (*sub*) *of Soda*.

Boron. (*Bore.*) A combustible substance, not metallic, pulverulent, of a greenish colour, insipid, inodorous, insoluble, infusible, without action upon oxygen at the ordinary temperature, absorbing it at an elevated temperature with an elimination of light; decomposing nitric acid, and passing to the state of boracic acid. This new substance is found in nature but in a state of combination with oxygen. Gay-Lussac and Thenard discovered it by treating boracic acid with potassium and sodium. In order to obtain it, equal parts of the acid and metal are introduced into a porcelain or copper tube hermetically sealed at one of the extremities. It is then heated to redness; one part of the acid is decomposed, giving off its oxygen to the potassium or sodium; the other part of the oxygen not decomposed combines with the oxide, and the result of the operation is the sub-borate of soda or potash, and boron. This salt is then dissolved in water, and the boron precipitated. This substance has been little studied.

Borides or **Borurets.** (*Borures.*) Combinations of boron with combustible bodies; but little is known of these compounds except that they are brilliant and insoluble. They are made by applying a high heat to a mixture of boracic acid, charcoal, oil, and iron filings, or a mixture of the acid and platina. The masses which result from these combinations have a metalloidal appearance, and are very fragile.

Brask. (*Brasque.*) Dust of pounded charcoal, with which crucibles are lined when treating bodies which have a strong affinity for oxygen.

Brandy. See *Alcohol.*

Brass. See *Alloys.*

Bread. (*Panis.*) Farinaceous vegetables are converted into meal by trituration, or grinding in a mill; and when the husk or bran has been separated by sifting or bolting, the powder is called flower. This is composed of a small quantity of mucilaginous saccharine matter, soluble in cold water; starch, which is scarcely soluble in cold water, but combines with that fluid by heat; and an adhesive gray substance, insoluble in water, alcohol, oil, or ether, and in many of its properties resembling animal substances. When flour is heated with water, it forms a tough paste, containing these principles very little altered, and not easily digested by the stomach. The action of heat produces a considerable change in the gluten, and probably in the starch, rendering it more easy to be masticated as well as to be digested. Hence, the first approach to the making of bread consisted in parching the corn, either for immediate use as food, or previous to its trituration into meal; or else in baking the flour into unleavened bread, or boiling it into masses more or less consistent; processes sufficiently indicated in the histories of the earlier nations, as well as in the various practices of the moderns. It appears likewise from the scriptures, that the practice of making leavened bread is of very considerable antiquity; but the addition of yeast, or the vinous ferment now so generally used, seems to be of modern date. Wheat contains much more gluten than rye and other grain; and this is the reason of the superior lightness of wheaten bread; for during the fermentation or rising of bread, much carbonic acid gas is evolved, which would escape from a mass of little cohesion; but the paste of wheat flour, being rendered cohesive and elastic by the gluten, retains the gas, which, in its endeavours to extricate itself, swells the mass, and renders it light and spongy, forming bubbles or cavities in the interior of the loaf. And here it may be proper to anticipate what would naturally come under the head of Fermentation. If the rising or fermentation of bread be continued too long, especially if the air have access, the acetous fermentation will take place, and vinegar will be produced. This is the cause of the sourness of bread. To remedy this, a solution of the carbonate of potassa (pearlash) is sometimes kneaded into the bread; the effect of this alkali being to unite with and neutralize the acid, forming an acetate of potash, while the carbonic acid of the carbonate of potash, being liberated from its base, renders the bread still more light, in its efforts to escape.

Bromic Acid. Has little odour, an acid taste, reddens powerfully litmus paper; it resembles iodic, chloric, and nitric acids; that is, it consists of one proportion of bromine, united with five of oxygen.

Bromide. This term is applied to certain salts which result from the union of bromine with metals and some other substances. Bromine combines with them in different proportions, forming proto and per bromides, as is the case with iron. Many of the salts thus formed appear in crystals, and some are soluble in water and alcohol. Their peculiar natures, however, have not been fully ascertained. It will be suffioient to mention the existence of bromides of antimony, arsenic, barium, bismuth, calcium, carbon, glucinum, gold, lead, magnesium, mercury, phosphorus, platinum, potassium, silver, sodium, sulphur, tin, and yttrium.*

Bromine. (*Brome.*) From *bromos*, fœtor, so called on account of its strong and unpleasant odour which resembles that of chlorine. It is highly destructive of animal life, and has been recently discovered by M. Ballard, a chemist of Montpelier, (France,) in the mother waters of salt works, and in the lixivia of the ashes of marine plants. It is a liquid of a deep red brown colour, very volatile, and its vapour resembles in appearance that of nitric acid. It boils at 117°; its density compared with water is about 3. It has extensive chemical affinities, forming acids and salts, as well as direct combinations with metals. Like oxygen, iodine, and chlorine, bromine is attracted to the positive pole, and is therefore said to be electro-negative. It was at first suspected that bromine might contain iodine; but experiments made by Professor De La Rive prove the contrary.

Brucine, or *Brucia*. An alkaline substance of a pearly white, similar to boracic acid; sometimes in a spongy mass, little soluble in water, insoluble in ether and fixed oil, but soluble in hot and cold alcohol; submitted to the action of fire, brucine is decomposed, gi ammoniacal products. It forms with acids, acid and neutral combinations. The sulphate, hydro-chlo (muriate,) and oxalate of this base, crystallize in the tral state: the nitrate and the phosphate crystallize but the acid must be in excess: the acetate is uncry lizable. Brucine is very bitter, notwithstanding its solubility. It was discovered by Pelletie rand Caver in the bark of the *Brucea anti-dysenterica;* it is t united to gallic acid. It has been discovered in *Strychnos ignatia,* (bean of St. Ignatius,) and the *Str nos nux vomica,* (vomica nut.) It is more easily obta from the brucea, this being the only alkali containe the plant. The process for obtaining brucine is as lows: a strong decoction of the plant is made with ter; oxalic acid is added to this which takes the bru from the gallic acid; the liquor is evaporated to an ext ive consistence; the residue is treated with cold alc which dissolves all the matter except the oxalate of cine. This salt is boiled with an equal part of ma sia to decompose it. The free brucine is redissolve alcohol, filtered in order to separate the oxalate of r nesia; by a slow evaporation, the alcohol deposites nute regular crystals. This substance is very poison but less so than strychnine. It is distinguished b property of becoming of a blood-red when a few d of concentrated nitric acid are poured upon it.

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* For a more detailed account of these salts we refer to Prof. Green's excellent "Text-book of Chemical Philosophy."

Butter. (*Beurre.*) A substance usually lemon loured, sometimes whitish, of a soft consistence, agreeable taste, slightly aromatic, lighter than water very easily melted. It soon becomes rancid when posed to contact with the air, particularly in sumn When salted it may be preserved for months. It been found only in milk, from which it is easily extr ed. The milk being left to stand a few hours, the cre rises and is taken off with a skimmer. By agitatio a vessel called a churn the particles of butter unite, and the cream is transformed into butter and buttermilk; the last is serum holding in suspension some butter and caseous or cheeselike substance. The butter is then washed in a large quantity of water and put up in firkins when designed for commerce. Butter always retains some caseous matter, which can be disengaged by melting it; according to Chevreul, it is composed of stearine, elaine, butyric acid, butyrine, and a small quantity of colouring matter. Very fine soap may be made with butter.

Butter of Antimony. A name formerly given to the proto-chloride of antimony. (See *Antimony.*)

Butter of Arsenic. See *Deuto-Chloride of Arsenic.*

Butter of Bismuth. See *Chloride of Bismuth.*

Butter of Tin. See *Deuto-Chlorate of Tin.*

Butter of Zinc. See *Chloride of Zinc.*

Butyrine. A substance very fluid at 66°, congealing at 32°; its odour is like that of melted butter; it is either yellow or whitish, according to the kind of butter from which it is obtained. Its density is 0·908. Chevreul discovered this substance in butter, united to stearine, elaine, and butyric acid. In order to obtain it, butter which has been purified by fusion is for several days exposed to a heat of 67°. The greater part of the stearine is deposited in little crystalline grains. The oily compound is carefully filtered, then mixed with an equal part of rectified alcohol; this mixture is exposed to a temperature of 67°, care being taken to shake it from time to time; the alcohol is then decanted; it is then distilled, and the residue is an oil rich in butyrine, which is disengaged by the carbonate of magnesia. The butyrate formed is dissolved in water, alcohol is again brought to act upon the remaining oily matter; after evaporating this solvent, nothing remains but pure butyrine.

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Cadmium. A metal of a whiteness resembling tin, having neither taste nor odour, more fusible than zinc, easy to volatilize. Oxygen has no effect upon it at the ordinary temperature, but if submitted to the action of caloric, it burns with flame, and forms an oxide of an orange yellow colour; it unites with most of the metals. Among the combustible bodies not metallic, chlorine, phosphorus, iodine, and sulphur are the only ones with which it has been combined. Cadmium has never yet been discovered in a native state; it has been found in mines of zinc in the state of a sulphuret and an oxide, but in very small quantities. MM. Stromeyer and Hermann discovered this metal in 1818. It is extracted by dissolving with heat *Calamine* in weak sulphuric acid, saturating this solution by a current of sulphuretted hydrogen; the sulphuret of cadmium, a little of the sulphuret of zinc, and sometimes sulphuret of copper, are formed. The different sulphurets are re-dissolved in hydro-chloric acid. Sulphuretted hydrogen is disengaged, and the chlorides of cadmium and zinc are formed; these are evaporated to dryness. The whole is dissolved in water, an excess of the carbonate of ammonia is added, the hydro-chlorate of ammonia is formed, and the carbonates of zinc and cadmium are precipitated; the carbonate of zinc is dissolved by the excess of the carbonate of ammonia, and that of cadmium remains insulated; the substances are filtered, the precipitate washed and dried; this with a mixture of lamp-black is heated to redness in an earthen retort. The cadmium sublimes in the neck of the retort. Its specific gravity is 8·64; on account of its scarcity it is of no use in the arts.

Caffein. (*Caféine.*) This substance has by chemists been regarded as a salifiable base, but it has not yet been sufficiently studied to pronounce with certainty upon its nature. It is soluble in water, and is extremely volatile. It crystallizes in long needles of a beautiful white. This substance is extracted from coffee.

Calamine. A name given to an ore of zinc, which according to Berzelius is a hydrated selenite of zinc, mixed with the carbonate of the same base.

Calcination. Oxidation. The fixed residues of such matters as have undergone combustion, are called cinders in common language; and *calces*, or now more commonly oxides, by chemists; and the operation, when considered with regard to these residues, is termed calcination. In this general way it has likewise been applied to bodies not really combustible, but only deprived of some of their principles by heat. Thus we hear of the calcination of chalk, to convert it into lime, by drawing off its carbonic acid and water; of gypsum or plaster of paris, of alum, of borax, and other saline bodies, by which they are deprived of their water of crystallization; of bones, which lose their volatile parts by this treatment, and of various other bodies.

Calcium. The metallic base of lime. The properties of this metal are little understood; it is however known to take oxygen from almost all substances, is destroyed by contact with the air, has a specific gravity greater than water, and is brilliant like potassium. This metal is obtained by making a paste with the sulphate of lime, or any other calcareous salt, and placing this paste in a vessel with mercury upon a metallic plate. The negative wire of the pile is brought in contact with the mercury, and the positive wire with the plate. The sulphuric acid and oxygen go to the positive pole, and the calcium to the negative, where it finds the mercury with which it amalgamates. This operation must be long continued in order to obtain an amalgam which contains a little calcium; this amalgam is introduced into a very small retort, with some of the oil of naphtha, a small receiver being fitted to the retort, the distillation is commenced. The oil in vaporizing driving the air from the retort, part of the mercury volatilizes, leaving a small quantity of calcium retaining still a little mercury.

Calculus. (A diminutive, from *calx*, lime stone.) This is a name given to all hard concretions, not bony, formed in the bodies of animals.

Calomel. (*Calomelas.* From *kalos*, good, and *melas* black; from its virtues and colour.) Name for the *Protochloride of mercury*. (See this word.)

Caloric. (From *calor*, heat.) It is an invisible, subtle, elastic fluid, which is capable of moving in the form of rays. It is known in three states: specific, radiated, and latent caloric. *Specific caloric* is that which different bodies absorb, in order to rise to a certain number of degrees, under a given weight and a common pressure. Several chemists have proved that this absorption was relative to the bodies; for example, that 1 pound of mercury at 32°, and 1 of water at 93·2°, gave a mixture at 91·4°; then the quantity of heat which can elevate the water 1·8°, can elevate the mercury to 91·4°.

Radiated caloric is that which emanates from all parts of a heated body, in rays which traverse the air with the greatest velocity. If these rays fall upon a polished surface, most of them are reflected; upon a rough surface, they are absorbed in a much greater degree, and the substance becomes sensibly heated. If two vessels with very smooth surfaces are exposed to the same degree of heat, they remain at the same temperature: if the surface of one of them is made rough, it will heat by the caloric radiated from the other. If two concave mirrors be arranged at the distance of a few feet from each other, and an ignited substance placed in the focus of one of these mirrors, the heat reflected from the opposite mirror, will be sufficiently great to set fire to tinder or sulphur, which being less polished than the surface of the mirror, will absorb the calorific rays.

Latent caloric is that which forms a constituent part of bodies, and which does not affect the thermometer; the fusion of metals, the resolution of ice into water, prove the existence of latent heat. If we take two pounds of pounded ice, or snow at 32°, and pour upon this substance 2 pounds of water at 167°, we shall obtain 4 pounds of water at the temperature 32°. The ice has then rendered latent all the caloric of the water employed. An essential property of caloric is its tendency to maintain an equilibrium. Every one knows that when two bodies of different temperature are brought in contact, the cold one gains caloric at the expense of the other, until the equilibrium is established; from thence result the two sensations known under the name of heat and cold. Our organs may become habituated to these sensations until they cease to feel them; bodies which at first seemed very hot or very cold, may cease to produce this effect. Thus in caves where the temperature during the whole year is at 50°, it seems much warmer in winter, and colder in summer.

Caloric moves through solid bodies with facility; if the end of a rod of metal be put into the fire, the other end will be almost immediately heated. If for the metal be substituted wax, wood, or coal, the end distant from the fire will scarcely change its temperature, while the other will be in a state of fusion; this fact proves that all bodies are not equally good conductors of caloric, and that this property seems to diminish with density; for liquids are very bad conductors, and gases seem to have no power of conducting this fluid. When boiling water is poured into a vessel containing mercury, the surface of the liquid will be very hot, while the bottom of the vessels containing the metal, will heat very slowly. This explains why the water of seas and lakes is usually hotter upon the surface than some feet below. Yet when a liquid is placed in a vessel over a fire, it soon boils; the particles of the liquid, near the bottom and sides of the vessel becoming heated, are lighter than the other particles, and rise to the upper part of the vessel; the other particles becoming in their turn heated, rise and take their place in the same manner, and thus there is an ascending and descending current at the same time.

Caloric by interposing between the molecules of bodies, increases their volume, changes those which were solid to liquids, and those which were liquid to gases; but if caloric is taken from these molecules, they resume their former state; those which were driven apart, return to a closer contact, and the caloric escapes on all sides. (See "*La Physique de M. Biot*," and "*Les Memoires de MM. Gay-Lussac et Dulong*.")

Calorimeter. An instrument invented by De La Place and Lavoisier, to ascertain the specific caloric of bodies. It consists of three concentric vessels of copper or tin, the interior one of net work of iron wire; the whole is covered with two concave perforated valves. The internal vessel is to contain the body to be examined; the intermediate and outer one to be filled with pounded ice. The exterior one serves only to secure the other from the action of the surrounding air; according to the quantity of water found in the middle vessel, is known the quantity of caloric which the body has furnished in order to bring the ice to a liquid state. The water is conveyed off by means of a stop-cock, with which the two outer vessels are supplied.

Calx. (*Calx, calcis,* from the Arabian *kalah* to burn.) Chalk. Limestone. From this term is derived the word *calcareous*, which signifies containing lime.

Camelion Mineral. A combination of potash with the per-oxide of manganese. This composition is due to Scheele, who discovered it by calcining the nitrate of potash with the per-oxide of manganese. Having dissolved in water the compound which he obtained, he saw that the solution which was at first given, took different shades; it became blue, then changed to violet, and then to red, and at length became colourless; acids changed the green to rose-coloured, while alkalies changed the green to red; on account of these changes of colour, this substance received the name of camelion. This compound is obtained by calcining a mixture of equal parts of the oxide of manganese and potash, when it is wished to form a camelion which would at once colour water green; but in order to colour red or purple, more of manganese must be added. The latter camelion dissolved in water, is permanent, and may be crystallized in needles of a dark purple. These acicular crystals have a sweetish taste; they are unalterable by the air, and possess in a high degree colouring properties. Nitric acid decomposes their solution; mixed with sulphur, phosphorus, and arsenic, they inflame spontaneously. According to MM. Chevillot and Edwards, (*Ann. de Chim. et de Phys.*) the camelion appears to be a manganesiate of potash; for there is evidently an absorption of oxygen during its formation.

Camphor is a peculiar vegetable substance, of a transparent white when purified, breaking easily, of a strong but agreeable odour; its taste is acrid and pungent; its specific gravity 0·9887. Camphor is not decomposed by the air; yet in time it wholly disappears. This is owing to its vaporization, and not to decomposition. It is easily dissolved in alcohol; is soluble in ether, the fixed and volatile oils, acetic and nitric acids; it burns like the essential oils, producing an abundant black smoke. It is, for commerce, extracted from the *Laurus camphora*, a tree which grows in Japan and the East Indies. For this purpose the wood is cut into small pieces, and distilled with water, in large iron cucurbits, with earthen heads filled with rice straw. The camphor carried upward by the vapour of the water settles upon the straw, in the form of greenish, pulverulent masses. It is transported in this state to Europe, where, in order to refine and purify it, it is pulverized and mixed with quick lime. M. Proust obtained a crystalline product from many labiate flowers, which he supposes differs little from camphor. According to Saussure, camphor is composed of 74·38 of carbon, 10·67 of hydrogen, 14·61 of oxygen, and 0·34 of nitrogen. Thompson has given a very different analysis.

Camphor, Artificial. A white crystalline substance, having some analogy to camphor in smell and also in dissolving in ether and alcohol; it is lighter than water, burning without any residue, not reddening litmus. This product was discovered by Kind, by saturating the essence of turpentine with one third of its weight of hydrochloric (muriatic) acid gas.

Camphorates. Combinations of camphoric acid with salifiable bases; these salts are little known; only those of ammonia, soda, potash, barytes, and lime, have been obtained; they are all decomposable by fire; and according to M. Bouillon-Lagrange the acid volatilizes without alteration, yet Bucholz, in decomposing the camphorate of lime, obtained acetic acid and oil. The camphorates are the products of art, and are prepared by a direct process.

Cantharides. *Musca Hispanica.* Commonly called Spanish flies; *Lytta Vesicatoria,* or the blistering fly. These flies have a green, shining, gold body; they are common in Spain, Italy, and other parts of the south of Europe. The cantharides have been the object of the researches of many chemists, the most successful of whom in this investigation are MM. Beaupoil and Robiquet. The last has succeeded in extracting the pure blistering substance; he also obtained a green oil, a yellowish and a black substance, acetic acid, nitric acid, and some phosphate of magnesia; the active substance of these insects has been called *cantharadin*.

Caoutchouc. *Indian Rubber*. *Elastic Gum*. A solid substance, white when pure, without taste or smell, soft, flexible, very tenaceous and elastic. It melts easily, produces on distillation a little ammonia; burns readily, leaving very little residue; it is unalterable by the air, and insoluble in water, alcohol, the alkalies and acids. M. Pelletier has found, that ether will dissolve it in small proportions. The volatile oils are the true solvents of this substance. It is extracted from the *Jatropha elastica*, *Urceola elastica*, and other trees of hot countries.*

Caphopicrite. A name given by M. Henry to the colouring matter of rhubarb.

Capsule. Segment of a hollow sphere, principally used for the concentration and vaporization of liquids. The bottom is sometimes round, sometimes flat; capsules are made of platina, silver, lead, porcelain, and glass; the last are little used.

Caput Mortuum, or *Terra Damnata*, a name given by the ancient chemists to the fixed residues which remained in the retort after distillation; being, as they supposed, absolutely worthless.

Carbo. (From *Charbah*, a Hebrew word signifying burnt or dried.) Coal.

Carbo-Muriates. (See *Chloro-Carbonates*.)

Carbon. (*Carbone*.) Is a simple substance which enters into the composition of all vegetable and animal matter; it is one of the most extensively diffused substances in nature. Pure carbon is solid, inodorous, insipid, and insoluble. That which is derived from the combustion of wood is black, porous, and easily reduced to powder; but in this state it is mixed with metallic oxides, salts, &c.; in the anthracite coal it is much more pure. It is sometimes found crystallized, in which state it constitutes the diamond, a substance so hard as to cut all others, while itself can be cut by none. Diamonds are usually limpid, sometimes without colour, sometimes rose coloured, brown, blue, yellow, or green. The most intense action of fire has no effect upon carbon, but it burns in oxygen gas at a very high temperature; it is necessary that the intenseness of the heat should be greater in proportion to the density of the carbon. Carbon combines but with few combustible bodies. One of its most remarkable properties is the avidity with which it absorbs different gases. The purest inflammable part of charcoal is what is usually called carbon; this united to oxygen forms carbonic acid. (See the word.) For the method of obtaining charcoal, see the article *Wood.*

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* A similar substance is said also to have been obtained from the juice of an American species of *Asclepias*, or milk weed. (See "Familiar Lectures on Botany," page 70.)

Carbonates, Double. The carbonate of lime unites with the carbonates of iron and magnesia, forming double carbonates; that of lime and magnesia is known by mineralogists under the name of *dolomite.*

Carbonates, Neutral. These salts differ from the sub-carbonate in containing double the quantity of carbonic acid; they easily crystallize, giving a green tinge to blue vegetable colours; they have little taste; that of ammonia, according to Berthollet, is without smell. Exposed to the action of fire they disengage a part of their acid, and become sub-carbonates. The air does not affect them. They effervesce with acids, and precipitate most of the soluble salts in the state of sub-carbonates, disengaging a part of the carbonic acid.

The following is the process for obtaining the neutral carbonates of soda, potash, and ammonia; carbonic acid is slowly added to a solution of their sub-carbonates, and gradually as saturation takes place, the salt becoming less soluble, crystallizes. It is then easy to separate it by decantation from the sub-carbonate which is not saturated; this preparation requires much time in order to obtain a small quantity. According to Thenard the neutral carbonates are composed as follows: that of potash, 100 of the acid and 106·686 of the base, that of soda, 100 of the acid and 70·693 of the base.

CARBONATES (SUB.) All these salts, except those of potash, soda, barytes, and perhaps lithia, are more or less easily decomposed by fire; the acid becoming entirely disengaged, the residue is the oxide of the metal, or the metal itself, if it is of the series of those which have little affinity for oxygen. Only the sub-carbonates of soda, lithia, and ammonia are soluble in water; many others dissolve in an excess of acid, such as lime, magnesia, &c. All the acids except the hydro-selenic, the hydro-sulphuric,* and the hydro-cyanic, decompose the subcarbonates, uniting to their bases and disengaging their acids; all the subcarbonates, except those of potash, soda, and lithia, which are soluble, are prepared by double decomposition; many are found in nature.

CARBONATE (SUB) of AMMONIA. A white caustic salt; it greens the infusion of violets, vaporizes gradually in the air, is soluble in cold water, and gasifies when dissolved in boiling water. It is obtained by putting equal parts of the sub-carbonate of lime and the hydro-chlorate (oxymuriate) of ammonia into a stone retort; the two salts decompose each other, forming the chloride of calcium and the carbonate of ammonia; the latter being volatile passes into a large receiver attached to the apparatus, and which is kept cool by cloths we with cold water. The sub-carbonate of ammonia appears to be formed of 100 of ammoniacal gas in volume and 50 of carbonic acid. It has been called *Englis Volatile Salt.*

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* Hydro-sulphuric acid is used by the French chemists to designate sulphuretted hydrogen.

Carbonate (Sub) of Baryta. It is found in nature, principally in England. It is insoluble in water, and dissolves in nitric acid without effervescence. According to Clement, it is composed of 78 of baryta and 22 of carbonic acid.

Carbonate (Sub) of Lime. (*Carbonate (Sous) de Chaux.*) This salt is of all others in nature, the most abundant; forming in various parts of the earth, extensive ranges of mountains. Marble, alabaster, stalactites, stalagmites, most kinds of building stones, lithographic stones, &c. &c, are only carbonates of lime in different states; it is sometimes found crystallized, and in this state presents various forms of the obtuse rhomboid, of which the great angle at the summit is 105°. It is decomposable by fire, and by most of the acids, and is found in nature so pure, as to render its preparation by an artificial process unnecessary.

Carbonate of Copper. (*Carbonate de Cuivre.*) This salt naturally forms upon the surfaces of copper vessels exposed to contact with the air. In nature it is found in different states; sometimes brown, composed of 78 of the oxide of copper and 22 of carbonic acid; it contains no water, and is therefore called *anhydrous;* sometimes it is green, compact, or earthy, crystallizing although rarely in rhomboidal prisms, and containing in 100 parts, 72 of the oxide of copper, 20 of carbonic acid, and 8 of water. This is known by the name of *malachite.* There is another carbonate of copper, which is of a beautiful blue, frequently crystallized in oblique rhomboidal prisms. and containing in 100 parts, 69 of the oxide of copper, 26 of carbonic acid, and 5 of water. These different carbonates are by the mineralogist considered as distinct species.

Carbonate (Sub) of Iron. (*Carbonate Sous de Fer.*) It exists in nature, in masses and in veins. It varies from a yellowish white to a brownish colour, and is sometimes found regularly crystallized. In the arts it is prepared by decomposing the sulphate of iron, by a solution of the sub-carbonate of potash or soda. In order to obtain a sub-proto-carbonate or sub-deuto, &c., it is necessary to employ a salt of iron which is at the first or second degree of oxidation, according to the salt desired; the precipitate must be washed, dried, and preserved in bottles well corked, that it may not pass to the last degree of oxidation, by absorbing oxygen from the atmosphere.

Carbonate (Sub) of Lead. (*Carbonate Sous de Plomb.*) It is found in beautiful acicular crystals, transparent, of a brownish yellow; it is very rare in nature. The sub-carbonate is of frequent use in the arts, where it is known under the name of *ceruse*, *white lead*, *&c.* It is procured for use in commerce by introducing a current of carbonic acid gas into a solution of the sub-acetate of lead; the sub-carbonate of lead which is thus formed is precipitated. Another very ancient process is to put plates of lead rolled spirally into earthen pots containing vinegar; these pots are placed under the ground; at the close of two months, being uncovered, the plates of lead are found almost entirely converted into sub-carbonate of lead and a small quantity of the acetate; the latter is separated by washing; all the acetate of lead dissolves, and the sub-carbonate is precipitated.

Carbonate (Sub) of Lithia. This salt is white, pulverulent, little soluble in water, strongly alkaline, undecomposable by fire, and unalterable by the air; it is the product of art, and obtained in the following manner: Acetate of barytes is poured upon a solution of sulphate of lithia, the sulphate of barytes is precipitated, and the acetate of lithia remains dissolved. The liquor is evaporated to dryness, and the acetate of lithia is decomposed in a silver crucible; a formation of the sub-carbonate of lithia and of carbon ensues; it is only necessary to lixiviate and to evaporate it in order to obtain the pure sub-carbonate.

Carbonate (Sub) of Manganese. It is sometimes of a pearly whiteness, sometimes rose coloured, is found in nature combined with the sub-carbonate of lime or iron; it is obtained in the same manner as the sub-carbonate of copper, iron, &c.

Carbonate (Sub) of Magnesia. This substance exists in nature, but not pure, being mixed with lime, silex, &c. It is frequently prepared in the arts, and is then very white, light, pulverulent, and greens the infusion of violets. It is decomposable by fire. In order to prepare it, a solution of the sulphate of magnesia should be poured upon the sub-carbonate of potash; an abundant precipitate is formed, which is separated by filtration; this is carefully washed to separate it from the sulphate of potash, and then left some days to drain. When it begins to acquire some degree of consistence it is put into little square boxes, where the drying is completed. It is prepared in such a manner as to be as light as possible.

Carbonate (Sub) of Potash. A very soluble salt, deliquescent, giving a strong green tinge to vegetable blues, of an acrid, caustic taste, not decomposable except by the strongest heat. It is not found in nature. By incinerating vegetables, and lixiviating their ashes, all the potash of commerce is obtained; it is always mixed with a little of the sulphate of potash, and the chloride of potassium; besides these substances, it contains a little of silex, the oxides of iron and manganese; the latter often gives it a green colour, forming a sort of *camelion.* In countries where wood is abundant, as in Russia, some parts of America, &c., in order to obtain this carbonate, vegetables are burnt upon the ground, the ashes are formed of the sulphate of potash, chloride of potassium, (all soluble salts,) alumine, silex, oxide of iron, manganese, lime, and the sub-phosphate of lime ; a little carbon escapes from the combustion, and a great quantity of the sub-carbonate of potash ; these ashes are evaporated to dryness, and the residue called *saline* is placed in reberberatory furnaces, where it is strongly calcined, in order to incinerate the little carbon which can have escaped combustion ; after being left to cool it is put up in close barrels ; this substance is used in commerce under the name of *potash*. This is impure, and as it is difficult to purify it completely, the sub-carbonate is obtained by decomposing at a red heat a mixture of the nitrate of potash (saltpetre) and the tartrate of potash, lixiviating the product and evaporating it to dryness. According to M. Guibourt, this salt often contains the cyanuret (cyanide) of potassium ; this is the case when the heat has been raised too high.

For use in the arts, are burned the dried lees of wine, which contain much of the tartrate of potash ; the alkaline residue is called *cendres gravelées*. If the sub-carbonate of potash is left exposed to the air, it attracts moisture, and soon becomes a liquid of an oily consistence, formerly called *l'huile de tartare par défaillance*. M. Struboni (*Ann. de Chim. et de Phys.*) has succeeded in crystallizing the sub-carbonate of potash in sharp acicular crystals. M. Vauquelin, having analyzed the sap of many vegetables, and never having found the sub-carbonate of potash, concluded that this is obtained only by the decomposition of the acetate, malate, tartrate, oxalate, and nitrate of potash, which are frequently found in vegetable substances.

CARBONATE (SUB) OF SODA. (*Carbonate sous de Soude.*) This salt, existing in beautiful quadrangular prisms, contains 62·69 for 100 of the water of crystallization; it is efflorescent, sharp, caustic, alkaline, more soluble in hot than cold water. Fire at first produces the watery, then the ignited fusion, which, like the preceding, it supports without undergoing any decomposition. The sub-carbonate of soda exists in many places, either in solution in the waters of certain lakes, or upon the surface of the earth, as in Egypt, Hungary, and America; but is never found pure. It is called, in this impure state, *natron.* Some plants which grow upon the borders of the Mediterranean furnish soda, such as the *salicornia*, *statica*, *atriplex*, &c. These plants when in the highest state of perfection are burned; the product of the combustion, which is in greenish masses, contains many heterogeneous substances, and is sold in commerce under different names, according to the countries from whence it is brought. The sodas of Alicant, Carthagena, Narbonne, and Normandy, are the most known. They contain in this state sub-carbonate of soda, sulphate of soda, sulphuret of sodium, muriate of soda, sub-carbonate of lime, alumine, silex, oxide of iron, charcoal, and sometimes the iodide of sodium.

In order to prepare a more pure sub-carbonate of soda, a mixture is made of 180 parts of dry sulphate of soda, 180 of powdered chalk, and 110 of the dust of charcoal; this mixture is put into a reverberatory furnace of an elliptical form, the temperature of which is above that of red heat; in a quarter of an hour the substance becomes clammy; it is then put in kettles, and cold water poured upon it; all the carbonate of lime formed by the decomposition of the chalk dissolves, while the sulphuret being insoluble when cold is not affected; the different waters of the lixiviations are united, evaporated to dryness, and exposed to the air, in order that the soda, yet very caustic, may pass to the state of a sub-carbonate; at the end of fifteen or twenty days, if the salt effloresces, it is lixiviated anew; after suitable evaporation, the liquor is left to crystallize by cooling. This salt was formerly called *salt of soda*, or *crystals of soda.*

Carbonate (Sub) of Strontian. This salt being of no use is never prepared in the arts, but is found in nature; it possesses properties very similar to the carbonate of barytes.

Carbonate (Sub) of Zinc. It is found with calamine in zinc mines, in the form of little crystals or in small lamellar masses. It can be artificially obtained like the sub-carbonates of lead and iron.

Carbonates (Sub) with double excess of base. These combinations contain twice as much of the bases, or a less quantity of the acid, than the sub-carbonates; such as the *malachite*, and the mortar of old buildings.

Carbonic Acid. See *Acid Carbonic.*

Carbonic Oxide. See *Oxide of Carbon.*

Carbo-Sulphuret. A term applied by Berzelius to the compounds formed by the union of the bisulphurets of carbon with the alkalies.

Carburets. (*Carbures.*) Combinations of carbon with simple bodies.

Carburet of Chlorine. See *Chloride of Carbon.*

Carburetted Hydrogen (Deuto.) (*Hydrogène Carboné.*) A gas of a bituminous odour, colourless and insipid; it does not support combustion. Its density (taking a medium from the analyses of many chemists) is ·9816. This gas exposed to different degrees of heat loses most of its carbon, increasing gradually in volume according to the intensity of the caloric; submitted to the highest temperature, it is increased 3 times in volume. Oxygen gas and atmospheric air have at the ordinary temperature no action upon it; but if the temperature is elevated, and the oxygen in excess, combustion takes place, producing water and carbonic acid.

If a mixture of carburetted hydrogen and oxygen in suitable proportions is inflamed under a glass vessel, a detonation takes place, more violent than can be produced by hydrogen alone. Carburetted hydrogen gas may be decomposed by a series of electric sparks, and all the carbon will be deposited on the sides of the vessel. It is little soluble in water. Chlorine produces various effects upon this gas: when a mixture of the gases is inflamed, either by the solar rays or otherwise, it suddenly detonates, is transformed into hydro-chloric acid, and carbon is deposited; but if this mixture remains exposed to a diffuse light and at the ordinary temperature, it forms an oleaginous compound, called *hydro-carburet of chlorine*, (*hydro-carbure de chlore.*) Iodine forms a combination known as the *hydriodide of carbon*, (*hydriodure de carbone.*)

Carburetted hydrogen gas is never found in nature; it is procured by submitting in a retort, at a mild heat, 1 part of alcohol and 4 parts of sulphuric acid; a tube fitted to the retort is placed under bell-glasses filled with water; the alcohol soon decomposes, and hydrogen, which is the result of this decomposition, is disengaged; a small quantity of sulphurous and carbonic acids is formed, and a little carbon deposited; the gas is purified by shaking it with a little potash-water. It is composed of 2 volumes of hydrogen and 2 volumes of the vapour of carbon. This substance, which was discovered by the chemists of Holland, was by them called *olefiant gas*. For purposes of illumination, a gas resembling it but containing more carbon is used with greater advantage than this. Deuto-carburetted hydrogen is obtained by distilling at a high temperature oils, oily seeds, and especially coal. See Thomson's Chemistry, for the particulars upon this subject.

Carburetted Hydrogen (Per.) (*Hydrogène Quadricarboné.*) It was for a long time believed that the deuto-carburetted hydrogen was that compound of hydrogen and carbon which contained this latter combustible in the greatest proportion; but it has been ascertained that when these two bodies are found in favourable circumstances, they combine so as to form a gas which contains 4 times as much carbon as the proto-carburetted hydrogen, and of course twice as much as the deuto-carburetted: this takes place when oleaginous seeds are decomposed at a temperature not too elevated; for as the deuto-carburetted hydrogen decomposes at a high temperature, much more does the per-carburetted, which contains more carbon, decompose at the same temperature. It is easy to imagine its properties after understanding those of the deuto-carburet. On account of the intensity of its flame, which is owing to its great quantity of carbon, it is very successfully used for lighting streets, houses, &c.

Carburetted Hydrogen. (Proto.) Insipid, of a disagreeable odour similar to the preceding; its density is 0.9716; mixed with oxygen or atmospheric air, it detonates like the preceding gases; it burns with a pale yellow flame; chlorine decomposes it at a red heat, but has no action upon it at the ordinary temperature. This gas exists in marshes, and at the bottom of stagnant waters, rising up in the form of bubbles; it is produced by the gradual decomposition of vegetables. It is common in the galleries of coal mines, and, before the discovery of Davy's safety lamp, rendered the working of them very dangerous. This gas gives rise to the meteors which are observed upon the declivities of the Apenines in Italy, and which are often seen in marshy places in damp and warm weather. It may be obtained by inverting vessels filled with water over the mud of stagnant pools or ditches; on stirring the mud, the gas rises into the vessels.

Carburet of Chlorine. (*Carbure de Chlore.*) See *Chloride of Carbon.*

Carburet of Iron (per.) (*Carbure de Fer.*) (*Black Lead.*) Plumbago. A shining substance of a dark gray colour, unctuous to the touch, leaving stains upon substances against which it has been rubbed. It is easily cut with a knife, and by rubbing acquires a metallic brilliancy. It is found in nature in primitve countries. Plumbago appears to be formed of 92 ot carbon, and 8 of iron.

Carburet of Iron (Proto.) See *Steel.*

Carburet of Sulphur. *Sulphuret of Carbon. Alcohol of Sulphur.* A liquid colourless compound, of a lively and penetrating odour, and a caustic teste. Exposed to the air, it vaporizes without decomposition, inflames at the approach of a burning substance, giving rise to sulphurous and carbonic acids, and a light deposite of sulphur. Water has no action upon the carburet of sulphur; it is dissolved by alcohol, ether, and the fixed and volatile oils. The carburet of sulphur is prepared as follows: Thoroughly calcined charcoal is to be put into a porcelain tube, that traverses a furnace at a slight angle of inclination; to the higher end of the tube, a retort of glass containing sulphur, is luted; and to the lower end is attached an adopter tube, which enters into a bottle with two tubulures, half full of water, and surrounded with cold water or ice. From the other aperture of the bottle, a bent tube proceeds into the pneumatic cistern. Heat being applied, the sulphur fuses, and is reduced to vapour; this, meeting with the charcoal, combines with it, and forms a carburet of sulphur which condenses in the porcelain tube. This compound was discovered by Lampadius; according to M. Vauquelin 100 parts of the carburet of sulphur are formed of 14.15 of carbon, and from 85 to 86 of sulphur.

Carmine. A lively red substance, granular, crystalline, unalterable by the air. Fusible at 122°, destructible by iodine and chlorine; decomposable by concentrated sulphuric, nitric, and hydro-chloric acids; very soble in water, and little soluble in alcohol, insoluble in the fixed and volatile oils, and in ether. The acetate of lead, hydro-chlorate (oxymuriate) of tin, and nitrates of mercury disturb this solution. Pelletier and Caventon, in analyzing cochineal, thus obtained this substance: After macerating pounded cochineal in ether, and heting to the boiling point, they continued to renew the ether until all the oily matter was removed. This cochineal is afterwards, with some alcohol, put into Chevreul's digester; the digestions are repeated, and the liquid is left to spontaneous evaporation. The carmine thus obtained still contains oily matter, which is separated by treating it with highly rectified alcohol; this dissolves only the carmine and the oily matter without attacking the animal matter. Ether is then added, the mixture is disturbed, and the carmine deposited in the form of little briliant grains, while all the oily matter remains in alcoholic ether.

CARTHAMINE. The properties of this substance are little known; it is of a very deep red colour, insoluble in water and alcohol; acids render the colour more lively, and potash and soda dissolve it, giving it a yellow tinge. It is extracted from the *Carthamus tinctorius.* (Rouge is prepared from the Carthamus.)

CATHARTINE. A substance which has been obtained from *senna*, and which is said to contain the cathartic principle of this plant.

CARTILAGE. An elastic, semi-transparent, animal solid, which affords one third the weight of the bones, when the calcareous salts are removed by digestion in dilute muriatic acid. It resembles coagulated albumen. Nitric acid converts it into gelatine. With alkalies it forms an animal soap. Cartilage is the primitive paste, in which the calcareous salts are deposited in the young animal. In the disease rickets, the earthy matter is withdrawn by morbid absorption, and the bones return into the state nearly of flexible cartilage. Hence arise the distortions characteristic of this disease.

Caseum. A white substance almost without taste; inodorous, heavier than water, without action upon vegetable blue colours. This substance is decomposed by fire, and furnishes much ammonia and carbon difficult to incinerate. It decomposes by exposure to the air, a reaction among the principles takes place, and it undergoes a sort of putrefaction. The caseous matter is insoluble in water; but alkaline solutions, particularly ammonia, easily dissolve it. Most acids produce the same effect. In order to obtain pure caseum, milk should stand until coagulated; the cream should then be taken off, and the residue washed with a large quantity of water.

Caustic Lunar. Fused nitrate of silver. See *nitrate of silver*.

Causticity. All substances which have so strong a tendency to combine with the principles of organized substances, as to destroy their texture, are said to be caustic. The chief of these are the concentrated acids, pure alkalies, and the metallic salts.

Cement. Whatever is employed to unite things of the same or different kinds, may be called a cement. In this sense it includes *lutes*, *glues*, and solders of every kind; but it is more commonly employed to purify those whose bases are an earth or earthy salt.

Cerasin. The name given by the Prussian chemist Dr. John, to those gummy substances which swell in cold water, but do not readily dissolve in it. Cerasin is soluble in boiling water, but separates in a jelly when the water cools. Water acidulated with sulphuric, nitric, or muriatic acid, by the aid of a gentle heat, forms a permanent solution of cerasin. Gum tragacanth is the best example of this species of vegetable product.

Cerin. (*Cerine.*) An oily substance analogous to wax extracted by Chevreul from wax; this substance is little known.

Cerium. A solid metal, brittle, lamellar, of a greenish white, very difficult to melt, volatilizing at a high temperature. This metal was in 1804 discovered by Berzelius and Hisinger, and afterwards investigated by Vauquelin and Klaproth. It is very rare, and only found combined with silex, the oxide of iron, or with lime, alumine, fluoric acid and yttria. It is extracted by treating in a crucible its purified oxide with charcoal, at a high temperature.

Cerulin. A name given by Mr. Crum to indigo when rendered soluble in water by exposure to strong sulphuric acid.

Ceruse. A name given in commerce to the sub-carbonate of lead or white lead.

Ceruse of Antimony. Some ancient chemist gave this name to the pearly matter which is separated by washing the diaphoretic antimony

Cetine. A name given by Chevreul to a white substance soft to the touch, brittle, insipid, very fusible, and volatile in a vacuum. It is extracted from spermaceti, of which it constitutes the greater part; in order to obtain it, spermaceti is heated with boiling alcohol; on cooling the mixture, cetine is deposited in the form of very light, lamellar crystals. Cetine vaporizes without forming glycerine; the products of the saponification are composed of ether, margaritic, and oleic acids.

Chaleur. See *Caloric*.

Chalumeau. See *Blow Pipe*.

Champignons. See *Mushroons*.

Chalk. See *Carbonate of Lime*.

Charcoal Animal. (*Charbon Animal.*) A black, carbonated, and very friable substance, is obtained by burning animal substances, particularly bones, in close vessels. It is purified by washing in hydro-chloric (muriatic) acid, in order to take away a portion of the lime, which is formed by the decomposition of the carbonate of lime contained in the bones. It possesses a high power of discolouring substances, and is much used in refining sugar.

MM. Bussy and Payen have, (in a memoir proposed for a prize subject by the school of pharmacy,) proved that the discolouring property was inherent in charcoal, and that it was greater in proportion as the charcoal by its minute subdivision offered more surface; that animal charcoal was better for this use, only because the animal matter isolated every molecule, and being destroyed by carbonization, prevented their union.

Charcoal of Wood. See *Wood and Carbon.*

Charcoal Mineral. See *Coal.*

Chaux. (*Lime.*) See *Oxide of Calcium.*

Chyazates. See *Hydro-Ferro-Cyanates, and Ferruretted Cyanides.*

Cheese. Milk consists of butter, cheese, a saccharine matter called sugar of milk, and a small quantity of common salt, together with much water.

Chemistry. (*Chimie.*) The name given to that science which has for its object a knowledge of the action molecular and reciprocal, which bodies exercise upon each other. Chemistry is of ancient origin, but it is only at the present day, that it has merited the name of science. It has risen from the ruins of alchymy; the alchymists having in their efforts to arrive at their grand discovery, (*grand œuvre*,) developed the first principles of chemistry.

Chlorates.[*] Combinations of chloric acid with salifiable bases. All the salts which result from this combination, are decomposed by fire; those of the first section are transformed into oxygen and chlorine, and the oxide of the metal; all the others, except the chlorate of ammonia, into a chloride and oxygen, and according to

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[*] Formerly called *hyper-oxygenated muriates.*

Vauquelin, a small quantity of chlorine. All the chlorates, except that of mercury, are soluble, and not acted upon by solutions of silver. All the strong acids decompose them, exhibiting various phenomena, according to the degree of heat employed.

Sometimes oxygen and chlorine are disengaged, sometimes the oxide of chlorine and oxygen. This species of salts was discovered by Berthollet; they are all the products of art.

Chlorate of Ammonia. *Hyper-oxymuriate of Ammonia.* According to Vauquelin it is obtained by pouring a solution of sub-carbonate of ammonia into chloric acid, and slowly evaporating the liquor. It crystallizes in little elongated needles of a very sharp taste. Fire decomposes it rapidly; the product is the hydro-chlorate of ammonia, nitrogen, the oxide of nitrogen, chlorine, and water. According to Gay-Lussac, the acid in volume is to the base as 1 to 2.

Chlorate of Barytes. *Hyper-oxymuriate of Barytes.* A very rare salt crystallizing in prisms, insoluble in alcohol. This substance, according to Wheeler, is obtained by dissolving with heat the chlorate of potash, and precipitating the potash by silicated fluoric acid. The mixture is heated, and all the potash forms a gelatinous mass with the silicated fluoric acid, whilst the chloric acid, and a little of the fluoric remain in solution; the liquor is filtered and saturated by the carbonate of barytes; it is a second time filtered, in order to separate the fluoride of barium, then evaporated and crystallized.

Chlorate of Copper. *Hyper-oxymuriate of Copper.* A bluish salt, almost uncrystallizable, deliquescent, reddening blue vegetable colours. It is obtained by combining directly the deutoxide of copper with chloric acid.

Chlorate of Lead. *Hyper-oxymuriate of Lead.* A white, insoluble salt, of a taste analogous to the salt of

Saturn. It is obtained in a similar manner to the deuto-chlorate of mercury.

Chlorate of Lime. *Hyper-oxymuriate of Lime.* This salt is little known; it is sharp, bitter, and deliquescent. It is obtained by direct combination.

Chlorate of Potash. *Hyper-oxymuriate of Potash.* A white salt, in scales like boracic acid, of a sharp and cool taste, fusible at a low temperature; decomposable at red heat into oxygen and the chloride of potassium. The chlorate of potash is obtained by passing chlorine through a solution of potash; as it is little soluble without heat, it is deposited at the bottom of the vessel under a lamellar form. In this operation one part of the potash is deoxidized, and the reduced metal uniting to the chlorine forms the chloride of potassium which remains dissolved; the oxygen of the potash unites to another portion of the chlorine, and produces chloric acid, which combines with the part of the potash not decomposed. (*Dulong.*) It is formed of 61·23 of chloric acid and 38·77 of potash.

Chlorate of Silver. *Hyper-oxymuriate of Silver.* It is prepared by pouring chloric acid upon the oxide of silver, newly precipitated and still moist (*Chenevix* and *Vauquelin.*) This salt crystallizes in prisms, and is, like all the chlorates, decomposable.

Chlorate of Soda. *Hyper-oxymuriate of Soda.* It possesses most of the properties of the chlorate of potash, having its taste and form, but it is much more soluble; it exhibits the same appearance when submitted to the action of fire. It is obtained by saturating the sub-carbonate of soda with chloric acid and evaporating it to a sirupous consistence.

Chlorate of Strontian. *Hyper-oxymuriate of Strontian.* It is obtained in the same manner as the chlorate of lime, of which it possesses most of the properties; it is easily distinguished by its power of communicating a purple colour to flame.

Chlorate of Zinc. *Hyper-oxymuriate of Zinc.* Crystallizes in octoedrons, fuses upon ignited charcoal, producing a yellow light. It is prepared by treating the carbonate of zinc with chloric acid.

Chlorates Oxygenated. Combinations of oxygenated chloric acid with bases. The salts which result from this union have been so little studied, that *oxygenated chlorate of potash* is almost the only one of which any thing is known. This is without colour, without action upon litmus, unalterable by the air, little soluble in cold, but much more so in boiling water. It is decomposed in the same manner as the chlorate of potash, with a disengagement of oxygen, and is converted into a chloride. These salts were discovered by Count Stadion. The oxygenated chlorate of potash is obtained by mixing one part of dry pulverized chlorate of potash, with two parts of concentrated sulphuric acid; this mixture must be often shaken, and the vessel containing it exposed to heat in a sand bath, until the odour and colour have disappeared. This mixture is diluted with water, the saline residue which remains upon the filter is washed, redissolved in boiling water, and the oxygenated chlorate crystallizes by cooling.

Chlorine. (From *kloros*, green, because it is of a green colour.) *Oxygenated muriatic*, or *oxymuriatic Acid.* A simple combustible body, not metallic. It is a gas of a yellowish green, of a taste and odour very disagreeable, and so strongly characterized as not to be mistaken for any other. Its gravity is 2·4216. It is a supporter of combustion, a wax taper burns in it with a dull reddish flame. Dry chlorine has never been solidified, or even liquefied, at the lowest temperature. If it is humid, it congeals below 32°. The highest temperature has produced no appearance of decomposition; like oxygen, it goes to the positive pole of the voltaic pile. Oxygen has no action upon it, unless the two gases are in contact, when chlorine is in a nascent state, (or evolving from its combination with other substances) in this case, four different combinations may take place. Hydrogen in the dark has no effect upon it, but if a mixture of the two gases is exposed to a diffuse light, they gradually combine, the greenish colour of chlorine disappears, and the result is a volume of hydro-chloric acid, equal to the two gases. If instead of exposing the mixture to diffuse light, it is exposed to strongly luminous rays, there will be a powerful detonation, and a very rapid combination will take place. The same phenomena may be observed if the mouth of a flask filled with this mixture be exposed to the flame of a taper, or if an ignited substance be introduced into the mixture.

Hydrogen and oxygen are not the only bodies which combine with chlorine; iodine, nitrogen, sulphur, phosphorus, and all the metals possess this property. Water dissolves once and a half its volume of chlorine. Chlorine is not found in nature except in a state of combination. Its discovery is due to Scheele, a pharmacian, of Lincoping, who named it *marine dephlogistic acid*, it was afterwards called *oxygenated muriatic acid*, or *oxymuriatic acid gas*. Berthollet, and Chenevix have paid much attention to the properties of this substance; the first made many important applications of it to bleaching. Gay-Lussac and Thenard have submitted it to such experiments as to establish a conclusion which throws light upon the study of its combinations, viz. that chlorine can be considered in no other light than that of a simple substance. Davy for a time opposed this theory, but at length giving up all his objections adopted it in full.*

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[*] The French here assume as a fact what is denied by English chemists. Dr. Ure says: "So far from the *chloridic* theory originating in France as has been *more than insinuated*, it was only the researches on iodine, so admirably conducted by *M. Gay-Lussac*, that by their auxiliary attack of the oxygen hypothesis, eventually opened the minds of its adherents, to the evidence long ago advanced by Sir. H. Davy."

Chlorine is thus obtained : six parts of hydro-chloric (muriatic) acid are poured into a matrass containing one part of the peroxide of manganese ; to the neck of the matrass is fitted a bent tube which is placed under water in the pneumatic cistern ; heat being now applied to the matrass, chlorine is disengaged ; it is collected, like most other gases, in receivers filled with water, which are inverted upon perforated shelves over the cistern. In this operation all the hydro-chloric acid decomposes, its hydrogen unites with the oxygen of the peroxide of manganese, and one portion of the liberated chlorine combines with the manganese, while the other portion is disengaged ; there is then in this process a formation of water, of the chloride of manganese, and a disengagement of chlorine.

Chlorine may be obtained also from a mixture of common salt (chloride of sodium) and the peroxide of manganese, in the proportion of 44 parts of the former and 1 part of the latter. Upon this mixture are poured 2 parts of sulphuric acid, diluted with its weight of water ; the process for obtaining the chlorine is then conducted as in the case above described. The phenomena of this operation are explained in several methods ; the following seems the most correct : the sulphuric acid, by its action upon the mixture, drives off the chlorine which was united to the sodium, (forming the salt,) and at the same time deoxidizes the manganese, reducing it to the state of a protoxide ; the oxygen unites to the sodium, forming a protoxide of sodium ; at the bottom of the retort remains a mixture of the proto-sulphates of manganese and sodium. (*Voy. Traité de Chimie de M. Thénard.*)

Chlorite. A mineral of a greenish colour.

Chlorides. (*Chlorures Métalliques.*) Combinations of chlorine with different metals. The chlorides are compounds so much resembling salts, that they have hitherto been known as such ; for example, the *chloride of so-*

dium,* (common salt,) which from remote antiquity has borne the name of salt, is not at present, in chemistry, acknowledged as such. The chlorides are mostly brittle, solid, and inodorous; (those of tin and arsenic are liquid;) crystallizing regularly; all the chlorides of the first five sections (*See Thenard's divisions of metals*) are undecomposable by fire; only one part of those of the last section are thus decomposable, as those of gold and platina. Water dissolves all the chlorides, except those of silver and the proto-chloride of mercury. Many chemists suppose that as soon as a chloride is dissolved, the water is decomposed, forming a hydro-chlorate; they found this theory upon the great affinity of chlorine for hydrogen, and that of oxygen for the metals; others think, with Dulong, that the solution is effected without any decomposition, because that chlorine has a great affinity for the metals, and that during their solution, none of the phenomena are produced which appear during their formation. What renders it difficult to decide upon either of these two hypotheses, is the circumstance that in the hydro-chlorates, the hydrogen and oxygen are exactly in proportions to form water. All the metals can unite with chlorine, and form chlorides corresponding to oxides; from thence the proto-chlorides, deuto-chlorides, &c.

The quantity of chlorine, in the chlorides, is to the oxygen of the oxide of the metal, as 4·388 is to 1; thus when a metal requires 1 of oxygen to become an oxide, it takes 4·388 of chlorine to become a chloride.

CHLORIDES NON-METALLIC. Combinations of chlorine with combustible bodies not metallic.

CHLORIDE of ANTIMONY (PROTO.) (*Proto-Chlorure d'Antimoine.*) A very caustic compound, white, deliquescent, decomposing water in the same manner as the nitrate of bismuth; it is very volatile, and may be separated by many processes; the first consists in making an intimate mixture of antimony and the deuto-chloride of mercury, introducing this mixture into a retort furnished with an adopter and a balloon, and then moderately heating the retort; the proto-chloride of antimony being very volatile, gasifies and condenses in the balloons. It is also obtained by treating the sulphuret of antimony with hydrochloric acid; the hydrogen of the acid unites to the sulphur of the sulphuret, and the chlorine being set free combines with the metal; the chloride is evaporated to dryness, and then sublimed in order to separate the impurities. M. Robiquet proposes another process, which produces a very beautiful chloride; it consists in dissolving 1 part of antimony in a mixture of 1 part of nitric acid, and 4 parts of hydro-chloric acid; the chloride which results is to be dried in close vessels, and submitted to the process of sublimation.

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* The chemical name for common salt was *muriate of soda*, until the discovery of chlorine changed the name to that of *chloride of sodium*. The substances described as *chlorides* will be found in many chemical books treated of as *muriates*.

CHLORIDE of ANTIMONY (DEUTO.) (*Deuto-Chlorure d'Antimoine.*) It is obtained by treating antimony with an excess of hydro-chloro-nitric (nitro-muriatic) acid; it is uncrystallizable, and partly decomposes if submitted to the action of fire. Water acts upon this deuto-chloride as upon the nitrate of bismuth.

CHLORIDE of ARSENIC. (*Chlorure d'Arsenic.*) A colourless liquid, very caustic, poisonous, and volatile; it diffuses in the air thick vapours. It is obtained, like the proto-chlorides of antimony, by distilling a mixture of metallic arsenic and corrosive sublimate. Arsenic possessing the property of inflaming when thrown into a flask of chlorine gas, this chloride may also be obtained by passing a current of dry chlorine into a tube containing fragments of arsenic. (*Thénard.*)

CHLORIDE of ALUMINUM. Deliquescent, colourless, and styptic; it is obtained by treating a jelly of alumine with hydro-chloric acid.

Chloride of Azote. See *Chloride of Nitrogen.*

Chloride of Barium. (*Chlorure de Barium.*) Very sharp, poisonous, crystallizes in large four-sided prisms, and liquifies by heat without being decomposed. The chloride of barium is obtained by heating for an hour a mixture of equal parts of the chloride of calcium and sulphate of barytes; these two substances in fusing, mutually decompose each other; the residue, composed of the sulphate of lime and the chloride of barium, is diluted in a sufficient quantity of water, filtered and slowly evaporated; the chloride of barium crystallizes on cooling. The presence of this chloride is tested by sulphuric acid, or a soluble sulphate, which instantly forms a white pulverulent precipitate of sulphate of barytes, insoluble in nitric acid. The presence of the chlorine which was united to the barium is also ascertained by a silver wire, which forms a precipitate wholly soluble in ammonia.

Chloride of Bismuth. Colourless, caustic, of an unctuous appearance; it has formerly been known in commerce under the name of butter of bismuth. It is, like the chloride of arsenic, obtained by a mixture of the metal with corrosive sublimate; it distils at a temperature a little above red heat.

Chloride of Calcium. Bitter, deliquescent, very soluble in water, crystallizes, but with difficulty, in six-sided prisms. If submitted to the action of fire it loses its water of crystallization. When a solution of sub-carbonate of potash is poured into the liquid chloride of calcium, it immediately forms a solid mass, which the ancient chemists called *miraculum chimicum*. The chloride of calcium exists in saltpetre beds, in the waters of the sea, and in many springs. It is easily obtained by saturating hydro-chloric acid with the carbonate of lime. In order to obtain it solid, we must evaporate the liquid to a pellicle and crystallize it; but for common use it is sufficient to evaporate it to dryness, and to preserve it in close vessels.

Chloride of **Carbon.** (*Chlorure de Carbone.*) Chlorine combines with carbon in two proportions. The *proto-chloride* is liquid, colourless, vaporizes at 165°, is not entirely decomposed but at a very high temperature. It is insoluble in water, but very soluble in alcohol, ether, and the oils; most combustible bodies decompose it, but at different temperatures. Chlorine changes it into a per-chloride. It is obtained by decomposing the deuto-chloride by heat.

The proto-chloride of carbon is formed of 100 parts of chlorine and 17·39 of carbon, or in volume of equal parts of chlorine and the vapour of carbon. The deuto-chloride is solid, crystalline, colourless; of an odour like camphor and resembling it a little in appearance. It melts at 255°, and vaporizes at 311°. At a higher temperature it decomposes, forming a proto-chloride. It is insoluble in water, ether, the fixed and volatile oils.

It is obtained by treating with chlorine the hydro-carbonate of chlorine,* and exposing the mixture to the sun. The hydro-chloric acid which is formed, is by water separated from the deuto-chloride which precipitates; this deuto-chloride is formed of 100 of chlorine and 11·59 of carbon; or of two volumes of the vapour of carbon and three volumes of chlorine; neither of the two chlorides exist in nature.

Chloride of **Cerium** (**Proto.**) This chloride which is little known, is obtained by the action of hydro-chloric acid upon the deutoxide of cerium, at the ordinary temperature; the boiling point is sufficient heat for its decomposition.

Chloride of **Chrome.** Green, very soluble in water. It is obtained by treating the hydrated protoxide of chrome with hydro-chloric acid, as the acid is entirely without action upon the dry protoxide; it may also be obtained by pouring chromic acid into hydro-chloric acid; the chloride of chrome and some water are formed.

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* This is the *olefiant* gas, termed by Brande the *hydro-chloride of carbon*. The French term is *hydro-carbone de chlore*.

Chloride of Cobalt. Bluish, deliquescent, astringent, scarcely crystallizable, very soluble in water. Its concentrated solution is blue when warm, but if diluted with water, it is at all temperatures of a rose colour; this explains the phenomena presented by sympathetic ink. It is prepared in the same manner as the nitrate of cobalt. (See *Blue of Thenard, or of Cobalt.*)

Chloride of Columbium. Almost unknown; it is prepared by treating columbic acid with hydro-chloric acid.

Chloride of Copper (Proto.) (*Proto-Chlorure de Cuivre.*) A white compound, by contact with the atmosphere passing to a green colour more or less dark. In order to obtain it, equal parts of minutely subdivided copper, and the deutoxide of copper are mixed; the mixture is introduced into a flask containing hydro-chloric acid, and afterwards carefully evaporated.

Chloride of Copper (Deuto.) Bluish, of a styptic taste, crystallizing in needles. Exposed to the action of fire, it disengages water and chlorine, and passes to the state of a proto-chloride; it is deliquescent. This substance is usually prepared by treating the deutoxide of copper with hydro-chloric acid; it often assumes a grass green colour.

Chloride of Gold (Deuto.) (*Deuto-Chlorure d'Or,*) Muriate of gold. Of a pale yellow colour, of a metallic and disagreeable taste, crystallizing in quadrangular prisms. According to M. Vogel, when dried in a vacuum it becomes green. Exposed to heat, it is first changed to a proto-chloride, and at length all its chlorine is disengaged. It is very soluble in water, and when dissolved is of gold yellow; it colours all vegetable and animal substances a reddish purple. Almost all the metals of the first five sections (see *Metals, division of*) effect its decomposition, also hydrogen, ether, the oils, sulphurous and phosphorous acids, &c. Many salts reduce the chloride of gold; the proto-sulphate of iron possesses this property in a peculiar degree.

The proto-chloride of tin reduces it also, precipitating it of a beautiful purple colour, known under the name of *purple precipitate of cassius*. Alkalies poured into a solution of the chloride of gold precipitate the gold in the state of an oxide; but if the solution is acid, it forms a triple chloride. If, instead of potash or soda, ammonia is poured into the solution, it forms a reddish yellow flocculent precipitate; these flakes well washed constitute *fulminating gold*. The chloride of gold is obtained by treating gold leaf with *aqua regia* (nitro-muriatic acid); or dissolving gold leaf in a solution of chlorine, and suitably evaporating the solution.

CHLORIDE of GLUCINUM. Colourless, crystallizable, very soluble, and of a sweet taste. It is obtained by treating the carbonate of glucina with hydro-chloric acid.

CHLORIDE of IODINE. (*Chlorure d'Iode.*) A deliquescent compound, of which one part is a bright yellow and the other an orange red. It is decomposed by water, which changes it into hydro-chloric acid and iodic acid, if the compound is yellow; but if it is red, it is changed into the ioduretted iodic acid. Iodine readily combines with chlorine, disengaging heat. (*Gay-Lussac.*)

CHLORIDE of IRIDIUM. This substance is not known in a state of purity; it is always united to the hydro-chlorate of ammonia, or to the chloride of potassium; in order to combine it with the chloride of potassium, it is necessary to calcine in a platina crucible iridium with twice its weight of the nitrate of potash. This product is afterward lixiviated, and the residue dissolved in hydro-chloric acid. This double chloride presents many phenomena which are little known. When dissolved it is at first blue, but if boiled with an acid, it passes successively to green, violet, and red. (*Voyez. le Memoire de M. Vauquelin.*)

Chloride of Iron. (*Chlorure de Fer.*) Greenish, styptic, very soluble, crystallizes easily. When dried, and exposed to the action of fire in a stone retort, it sublimes in little white spangles. The atmosphere acts upon the chloride of iron much the same as upon the sulphate. This chloride can be obtained by putting iron filings into a gun barrel, to one end of which is fitted an adopter; when the gun barrel is heated to redness, a current of dry chlorine is introduced into it, and the chloride of iron is formed in the adopter. If the hydrochlorate of ammonia is mixed with chloride of iron, the result is a yellow volatile compound, which was formerly called *martial flowers*; this is only an intimate mixture of the hydro-chlorate (muriate) of the same base and the chloride of ammonia.

Chloride of Lead. (*Chlorure de Plomb.*) White, sugared, astringent, more soluble by heat than cold; crystallizes in hexahedral satin prisms. Submitted to the action of fire, it melts in a grayish mass, formerly called *horned lead* (*plomb corné.*) At a red heat it volatilizes in thick vapours. All the soluble sulphates decompose it. It is sufficient, in order to obtain this chloride, to treat litharge (deutoxide of lead) with boiling hydro-chloric acid diluted with five or six times its weight of water.

Chloride of Lime. (*Chlorure de Chaux.*) It is the combination of chlorime with the protoxide of calcium. It is frequently employed in the arts. It possesses the bleaching property of chlorine, and the power of preserving animal substances from putrefaction. It is prepared by introducing chlorine gas into a kind of chamber furnished with little shelves, which are covered with pieces of lime. Clement advises to employ in its preparation the hydro-chloric acid which is disengaged in the manufacture of artificial soda. It would be necessary to collect it when it is obtained from the muriate of soda, by sulphuric acid, and to cause it to pass over a chemical cascade* containing fragments of the peroxide of manganese; the acid then would be decomposed, and arrive in the state of chlorine to the place containing the lime.

CHLORIDE of LITHIUM. Uncrystallizable and deliquescent. It is obtained by treating the sub-carbonate of lithia with hydro-chloric acid.

CHLORIDE of MAGNESIUM. Uncrystallizable, bitter, very soluble. It is obtained like the preceding. This chloride is usually decomposed by fire. Gay-Lussac has published a method for obtaining it in such a state as not to be affected by the most intense heat. This method consists in introducing magnesia into a porcelain tube, and passing through it a current of dry chlorine; all the oxygen is set free, and combination immediately takes place.

CHLORIDE of MANGANESE. White, styptic, very soluble, deliquescent, crystallizes by spontaneous evaporation. It is obtained by treating the peroxide of manganese with an excess of hydro-chloric (muriatic) acid.

CHLORIDE of MERCURY (PROTO.) (*Proto-Chlorure de Mercure.*) Calomel. White, insipid, volatile; it crystallizes in tetrahedral prisms terminated by 4-sided pyramids. Exposed to the air for a certain time, it becomes yellow, and then black. It is wholly insoluble in water and hydro-chloric acid. Chlorine dissolves it, changing it into a deuto-chloride. If ammonia or a solution of soda or potash is poured upon the proto-chloride of mercury, it immediately becomes black. This compound is not decomposable by fire; but the simultaneous action of water and charcoal changes it into metallic mercury, while hydro-chloric acid, produced by the decomposition of water, is disengaged. There are various methods for obtaining the proto-chloride of mercury; the most approved are the following:

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* Clement gives the name of *cascade chimique* to a hollow cylinder, whose breadth and length vary according to circumstances. This cylinder is filled with fragments of some kind of substance, which usually has no action upon the substance that is to pass over, but which may sometimes affect it, as in the case of peroxide of manganese, and muriatic acid. These fragments in the cylinder serve to increase the surface of the liquid or gas which passes through.

1st. Pour a concentrated solution of the chloride of sodium (common salt) into a similar solution of the proto-nitrate of mercury; a precipitate of the proto-chloride of mercury is formed; this is sometimes called *white precipitate.*

2d. Form, by saturation, an intimate mixture of 1 part of corrosive sublimate slightly moistened with 1 part of metallic mercury, and submit this mixture to sublimation.

3d. Prepare a mixture of the proto-sulphate of mercury and the chloride of sodium, as for corrosive sublimate; then proceed to the sublimation in a flat-bottomed matrass; this last process is most approved.

The proto-chloride obtained by these methods always contains a little corrosive sublimate, which is formed during the operation; it is divested of this by washing. This compound has been called *mercure doux, mercure sublimé doux, panacée mercurielle, calomel, calomelas, draco mitigatus,* &c.

CHLORIDE of MERCURY (DEUTO.)[*] *Oxymuriate of Mercury. Corrosive Sublimate.* White, crystallizable, soluble, of a styptic and disagreeable taste; treated with phosphorus, it decomposes, forming the chloride of phosphorus, and restoring the mercury. Charcoal produces no effect upon it, even at a high temperature. Alcohol and ether easily dissolve it, at the ordinary temperature. It dissolves in three times its weight of boiling water; and on cooling, crystallizes in fine satin needles; ammonia produces in its solution a white precipitate; potash, soda, and lime, produce a brick-coloured precipitate, which afterwards becomes yellow, if the alkali is in excess. Equal parts of the hydro-chlorate (muriate) of ammonia and the deuto-chloride of mercury, sublimed together in a phial, give a compound which easily sublimes; the residue of this sublimation is very difficult to vaporize.

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[*] This is also called the *per-chloride.*

These two compounds differ from each other but by their principal constituents; the most volatile, an ammoniacal deuto-chloride, was known to the ancients under the name of *sal alembroth*, salt of wisdom, &c.; both of these compounds are more soluble in water than corrosive sublimate. The most common process for preparing this deuto-chloride is as follows: 5 parts of sulphuric acid, aided by heat, are made to act upon 4 parts of mercury; heat is continued until the whole is reduced to 5 parts; then this acid deuto-sulphate is mixed with 4 parts of pulverized chloride of sodium and 1 part of the peroxide of manganese; after a few days, the mixture is introduced into little flat-bottomed matrasses, surrounded to the neck with sand; the mouth is covered with a small glass capsule. On being heated, sublimation takes place; there is a re-action upon the peroxide of manganese and the chloride of sodium, by the sulphate of mercury. A heavy white mass is formed upon the sides of the vessel; this operation continues from 15 to 18 hours; towards the close, the bottom of the sand-bath must be brought to a red heat, in order to give to the sublimation greater density by commencing its fusion.

CHLORIDE of MOLYBDENUM. Is obtained in the same manner as the chloride of columbium.

Chloride of Nickel. When hydrated, it is grass-green; in a dry state, yellowish green; it is very soluble and sugared. According to M. Lassaigne, this chloride, heated in a retort to a high temperature, sublimes in part to the state of an insoluble deutoxide of a gold-yellow; and the fixed residue is a sub-chlorate; it is prepared in the same manner as the nitrate of nickel.

Chloride of Nitrogen. (*Chloride of Azote.*) Very volatile, vaporizes in the atmosphere, diffusing a suffocating odour; it detonates powerfully at 86°, especially if a small piece of phosphorus is placed in contact with it; copper decomposes it, disengaging the nitrogen; it is preserved in flasks under distilled water. The preparation of this chloride is attended with some danger; it is necessary that the nitrogen should be in a nascent state, or come in contact with chlorine at the moment when the former gas is escaping, otherwise no combination will take place; for this purpose an ammoniacal salt is dissolved in water, and a current of chlorine is carefully introduced into the solution. The chloride of nitrogen, being heavier than water, is found at the bottom of the vessel; but the greatest precaution is necessary to prevent accident from explosion. It was discovered by Dulong, in 1811; this learned chemist was twice wounded in studying this singular compound.

Chloride of Palladium. Colour brownish; crystallizing with difficulty. This compound forms with potash and soda, triple chlorides which possess the property of crystallizing. The proto-sulphate of iron instantly reduces the chloride of palladium. It is obtained by dissolving palladium in aqua regia. This chloride has been particularly investigated by Vauquelin and Wollaston.

Chloride of Platina. Of an orange yellow, a styptic taste, soluble in water, and affecting iron like the chloride of gold.

Chloride of Phosphorus (Proto.) (*Proto-Chlorure de Phosphore.*) Liquid, volatile, colourless, transparent, heavier than water, and very caustic; reddening the tincture of litmus, but having no action upon dry litmus paper. In contact with water, this substance decomposes rapidly, and is transformed into hydro-chloric (muriatic) and phosphorous acids. A process, proposed by Davy for obtaining this chloride, is to add 1 part of phosphorus to 7 of the deuto-chloride. The proto-chloride of phosphorus was discovered by Gay-Lussac and Thenard; according to them, it is composed of 100 of phosphorus and 327·6 of chlorine.

Chloride of Phosphorus (Deuto.) Solid, very volatile, colours litmus paper red, and crystallizes in transparent prisms. Oxygen, hydrogen, and the metals, decompose it at red heat. It decomposes water very rapidly, changing it into phosphoric and hydro-chloric (muriatic) acids. It is obtained by introducing chlorine into a small matrass containing dry phosphorus, and continuing this operation until all the phosphorus is transformed into a white pulverulent matter. Some chemists have regarded the chlorides of phosphorus as acids; and have given them the name of *chloro-phosphorous* for the proto-chloride, and *chloro-phosphoric* for the deuto-chloride. Whatever names be given them, the latter forms with ammonia a triple compound, fixed, insoluble, and undecomposable by the alkalies, which may be considered a chloro-phosphate. The deuto-chloride of phosphorus was discovered by Davy.

Chloride of Potassium. Colourless, bitter, sharp, a little deliquescent, crystallizes in 4-sided prisms, and decrepitates with fire. It is found in some waters, in vegetable and animal fluids. It is obtained directly from hydro-chloric acid and the sub-carbonate of potash. It was formerly known under the name of *febrifuge salt of Sylvius.*

Chloride of Rhodium. This compound is hardly known. It is easily obtained by treating one of the oxides of rhodium with hydro-chloric acid.

Chloride of Silver. (*Chlorure d'Argent.*) White, without taste, fusible at a low heat, it takes a massive form in cooling; it then has a grayish appearance, and is easily cut with a knife. It was formerly called *horned silver*, (*argent corné*,) on account of its appearance. The acids are mostly without action upon this chloride; boiling sulphuric acid decomposes it; ammonia entirely dissolves it. It is found, though seldom, in nature. By treating metallic silver with hydro-chloric acid, or even by decomposing a salt of silver by the chloride of sodium, a precipitate is obtained which is the chloride of silver.

Chloride of Sodium. (*Chlorure de Sodium.*) *Muriate of soda*, *common salt*, *sea salt*, *mineral salt*, &c. Crystallizes in cubes, transparent. Its taste is agreeable to most animals. Submitted to the action of fire, it loses its water of interposition, and at a temperature above red heat experiences the igneous fusion without any decomposition. Salt is one of the most common substances in nature. It is found in a liquid state or in solution, as the waters of the sea, salt lakes, and springs, and in a solid state (*sel gemme*) in mines.

Mineral salt, (*sel gemme*,) often called *rock salt*. This is found in many places, particularly in Poland, Moldavia at the foot of mount Krapack, where a mine of it extends more than 150 leagues. Asia, Africa, and America contain inexhaustible mines of salt. Only one mine (recently discovered, near Vic in the department of Meurthe) is known in France; this is so rich, as to be sufficient for the supply of all Europe, for thousands of years. Salt is usually found in connection with argillite; sometimes a mine extends to a great depth, as in Poland, where they have already penetrated three hundred feet below the level of the sea; it is sometimes found in mountains at the most elevated heights, as in the Cordilleras, but most commonly it is situated at the base of high mountains. Mineral salt is transparent, sometimes blue, yellowish, or violaceous; in order to purify it, we must dissolve and evaporate it.

Sea salt (*sel marin.*) A great part of the salt used in commerce is obtained from salt water. Many processes are employed for its preparation. When the waters contain a large proportion of salt, it is extracted by concentrating these waters by fire in large iron caldrons. During evaporation, a substance composed of the double sulphate of lime and soda, which the manufacturers call *schlot*, is precipitated; the salt is evaporated almost to dryness; it is then drained and dried. In warm countries the heat of the sun is sufficient for the evaporation of salt water. For this purpose clay basins are dug near the sea coast, which are called brine pits; the first of these basins is a vast reservoir which receives the water from a canal provided with a sluice; from this, by means of a slight descent, it is distributed into other smaller and more shallow basins, which communicate with each other in such a manner that the water before it enters them makes a great circuit. As soon as the water appears diminished the basins are replenished. When about to crystallize, the salt assumes a reddish hue, it is then left to deposite the crystals. From time to time the salt is drawn out and left upon the banks to dry. This operation is usually commenced in April and completed in September. Other methods are employed, particularly in evaporating the waters of salt springs.* In all these operations the salt obtained is not pure, as it contains chlorides of calcium and magnesia, of which it may be divested by crystallization.

CHLORIDE of STRONTIUM. Colourless, sharp and irritating to the taste, soluble in once and half its weight of cold water; it crystallizes in long needles, which like the wire of strontian, produce with combustible bodies a purple flame. It is obtained in the same manner as the chloride of barium.

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* These operations, upon a very large scale, may be witnessed at Salina, N. Y.

Chloride of Sulphur. Liquid, reddish brown, very volatile at the ordinary temperature, of a sharp disagreeable smell, strongly reddening the tincture of litmus. When in contact with the atmosphere, it diffuses thick vapours; agitated with water, a lively ebullition takes place, caloric is disengaged, a little sulphur deposited, and a solution of sulphuric, sulphurous and hydro-chloric acids is obtained. The same phenomena are produced with it by ether and alcohol. The chloride of sulphur poured upon mercury, tarnishes the surface of the metal, and forms upon it a grayish pulverulent crust of the sulphurot and the chloride of mercury. The chloride of sulphur is obtained by introducing dry chlorine upon the flowers of sulphur placed at the bottom of an *eprouvette*, the chlorine passing in by means of a bent tube. This operation must proceed slowly, and terminates where all the sulphur has disappeared. The knowledge of this substance is due to Thompson.

Chloride of Tellurium. Colourless and uncrystallizable: its solution with water, deposites a white precipitate. It is obtained by treating tellurium with *aqua regia*.

Chloride of Tin (Proto.) (*Proto-chlorure d'Etain.*) White, very astringent, more soluble at a high than a low temperature, crystallizing in little needles; it takes oxygen from many compounds. In contact with the atmosphere, its solution is disturbed, and the deuto-chloride and the deutoxide of tin are formed. Molybdic, chromic, and arsenic acids are precipitated in the state of oxides by the same solution. It precipitates in the metallic state the chlorides of gold and mercury, and passes itself to the state of a deuto-chloride. The proto-chloride of tin is obtained by treating fragments of tin with liquid hydro-chloric acid; hydrogen is disengaged, and the chlorine unites to the metal. The solution is evaporated, and crystallizes in cooling. This compound is poisonous, and little employed in the arts.

Chloride of Tin. (Deuto.) Liquid, transparent limpid, volatile, and of an insupportable odour. Exposed to the atmosphere, it absorbs water and diffuses a thick vapour. In contact with water, it rapidly absorbs it, and crystallizes in little white styptic needles. It is obtained by passing an excess of chlorine into a solution of the proto-chloride, and concentrating the liquor by evaporation; or by amalgamating 1 part of mercury, and 3 parts of tin, pulverizing the amalgam, and mixing it intimately with its weight of corrosive sublimate, afterwards introducing this mixture into a retort, furnished with a receiver, surrounded with wet cloths. As it is very volatile, it needs but a low heat for its distillation. The deuto-chloride of tin was discovered by Libavius, from whence it received the name of *liqueur fumante de Libavius*. This compound has been successively studied by Pelletier, Cadet, Proust, and Davy.

Chloride of Titanium. Yellowish white, and uncrystallizable. It is obtained by calcining the oxide of titanium with the sub-carbonate of potash, and carefully lixivating the mass in order to separate the alkali, and heating the remainder with concentrated hydro-chloric acid.

Chloride of Thorinum. Uncrystallizable; when evaporated, it becomes insoluble, and like a white enamel. It is obtained by dissolving the carbonate of thorinum in hydro-chloric acid.

Chloride of Tungsten. (Deuto.) Crystallizes in fine red needles, and is produced by burning metallic tungsten in chlorine gas. By water this salt is changed into hydro-chloric acid and oxide of tungsten. If this oxide is now heated in chlorine, the *per-chloride* of tungsten is generated in the form of white crystalline scales. Wohler mentions another chloride, existing in transparent red crystals; its composition, however, has not yet been accurately determined.

Chloride of Uranium. Yellowish green, deliquescent, crystallizing with difficulty. It is obtained by treating the oxide of uranium with hydro-chloric acid.

Chloride of Yttrium. Colourless, deliquescent, sugared, almost uncrystallizable. It becomes a jelly by evaporation. It is obtained by treating the carbonate of yttria with hydro-chloric acid.

Chloride of Zinc. White, styptic, emetic, deliquescent, volatile, of an oily appearance. It is obtained by dissolving the metal in hydro-chloric acid, evaporating it to dryness, and submitting the residue to sublimation. It was formerly called *butter of zinc* (*beurre de zinc.*)

Chloride of Zirconium. Colourless, styptic, very soluble, crystallizes in little needles. It is obtained by treating the jelly of zirconium with hydro-chloric acid.

Chlorophylle. A name given by Pelletier and Caventon to the green substance which colours plants. It was formerly called the *green fecula* of *plants*. Its colour is of a deep green, its appearance resinous; when pure, it has neither odour nor taste; it is undecomposable by atmospheric air; insoluble in alcohol, ether, and the oils.* Sulphuric acid dissolves this substance without decomposing it; and it may probably be precipitated without decomposition, by saturating the acid with an alkali; the alkalies exhibit with it similar phenomena. Chlorine and iodine change its colour, the former to a green, and the latter to a yellow. It is obtained by coagulating the green juice of plants with heat, and purifying the coagulum with water and alcohol. (*Voyez le Memoire de MM. Pelletier et Caventon.*)

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* Dr. Ure says it is soluble in these substances.

Cholesterates. Combinations of cholesteric acid with bases. All the salts which result are coloured either yellow or orange. The cholesterates of soda, potash, and ammonia, are soluble and deliquescent; all the others are insoluble. All the mineral acids except carbonic acid, and most of the vegetable acids, decompose the cholesterates.

Cholesterine. A name given by M. Chevreul to the crystalline substance of the human biliary calculi. It exists in brilliant white scales, is insipid, melts at 246°, and crystallizes on cooling. Boiling alcohol dissolves it. Distilled by fire, it gives neither acid nor ammonia; nitric acid converts it into cholesteric acid. This substance is obtained by submitting the biliary calculi to the action of boiling alcohol; by filtration and cooling, the cholesterine separates in beautiful micaceous scales, which are purified by new solutions.

Chromates. Combinations of chromic acid with bases. The salts which result from this union are all coloured. Most of the chromates of the first section, (see *metals*, Thenard's sections,) and those of the last four, are decomposed at a high temperature. Few of them are soluble. Sulphuric, nitric, and hydro-chloric acids appear to decompose them all at the ordinary temperature. The most common chromates are the following:

Chromate of Ammonia. Is obtained by treating, at the ordinary temperature, the chromate of lead by a solution of the sub-carbonate of ammonia, filtrating the liquor, and submitting it to evaporation.

Chromate of Barytes. Insoluble, of a pale yellow. It is like the preceding, obtained by decomposing the chromate of potash with the nitrate of silver.

Chromate of Lead. (*Chrômate de Plomb.*) Of a brilliant yellow in the neutral state, and a beautiful orange in the state of a sub-salt. It is obtained by pouring a solution of the chromate of potash into the neutral acetate of lead, if a yellow colour is desired; or if a orange, into the sub-acetate of lead.

CHROMATE of LIME. (*Chrômate de Chaux.*) Yellow soluble, and crystallizable. It is prepared by treatin the hydrate of lime with the chromate of lead.

CHROMATE of MERCURY. (*Chrômate de Mercure.*) Red, and insoluble. It is obtained like the chromate o silver.

CHROMATE of POTASH. A salt in rhomboidal prisms, of a lemon yellow, a bitter and disagreeable taste. Submitted to a high temperature, a little of the acid decomposes; it takes a green hue on liquefying. This substance is very soluble in water, and little so in alcohol. Potash can combine with an excess of chromic acid; and the salt is then, instead of being yellow, of an intense orange colour. It crystallizes in large rectalinear tables, is unalterable by the air, and much less soluble than the neutral chromate. In order to obtain these two chromates of potash, one part of pulverized ore of chromium, and one part of saltpetre, are put into a crucible, and strongly heated for two hours in the reverberatory furnace. The nitrate of potash, (saltpetre,) is decomposed; disengaging the deutoxide of nitrogen, and forming chromate of potash mixed with the oxide of iron and other substances, which made part of the mineral. The yellow porous substance which remains in the crucible is treated with water, and boiled for a quarter of an hour; it is then filtered, and the liquor partly evaporated: nitric acid is then added; this changes the liquor to an orange colour, and at the same time precipitates the silex and alumine which had been dissolved by some of the alkali. The new liquor being filtered a second time, alkali is added until it becomes yellow; after which it is concentrated, and all the nitrate of potash successively crystallized. It is concentrated anew, and the chromate of potash is in turn crystallized. (*Thenard.*)

Chromate of Silver. (*Chrômate d'Argent.*) Of a deep purple, insoluble. It is obtained by decomposing the chromate of potash by the nitrate of silver.

Chromate of Soda. (*Chrômate de Soude.*) Yellow, very soluble, crystallizes easily; it is obtained in the same manner as the chromate of potash, except that the nitrate of soda is employed instead of the nitrate of potash.

Chromate of Strontian. Resembles the chromate of lime, and is obtained in the same manner.

Chromium. (*Chrôme.*) (From *chroma*, a colour.) A solid brittle metal, of a grayish white. As it is almost infusible, it has been obtained only in a porous mass. Its specific gravity is unknown. Chromium is unalterable by the air, but in a red heat it absorbs oxygen. Its cohesion is so great as not to be overcome by any acid. Sulphur, phosphorus, and chlorine, are the only combustible non-metallic substances which have been combined with chromium. The discovery of this substance was made by Vauquelin in analyzing the chromate of lead from Siberia. Chromium exists in nature only in the state of a chromate or an oxide. It is extracted from the oxide by calcining it with charcoal at a high temperature. M. Laugier first observed chromium in native iron and in the *areolithes.*

Chrysocolle. A name from the Greek, given to borax on account of its being used to solder gold and other metals.

Chyle. An animal liquor, of a milky colour, a sweetish and saline taste, heavier than water, greening the infusion of violets; left to itself, chyle coagulates like blood, and is changed into two parts, a solid and a liquid; a little oil also collects upon its surface. The liquid resembles the serum of blood; it holds in suspension an oily substance, soluble in alcohol and insoluble in the alkalies. The solid part, or curd, is a mixture of oily matter, fibrine, and serum. For farther details, see the Memoirs of M. Vauquelin and the labours of Dr. Marcet.

Chyme. Is a pulpy matter, of an odour common to the animals whose stomachs furnish it. This substance appears to dissolve in acetic acid; it does not contain gelatine, but a certain quantity of albumen. The analysis of human chyme has not yet been made. Dr. Marcet has analyzed that in the stomach of the turkey.

Cinchonine. A vegetable alkaline substance, white, translucid, crystalline, little soluble in warm water, and almost wholly so in cold water, of a slightly bitter taste, but decidedly bitter when dissolved in an acid. Fire decomposes one part, and volatilizes the other. Cinchonine restores its blue colour to litmus which has been reddened by an acid, and forms with acids perfectly neutral combinations. Mr. Duncan of Edinburgh first obtained a crystalline substance from the quinquinas.* Gomez described this substance under the name *cinchonin;* Laubert afterwards undertook to investigate the same substance, which he obtained tolerably pure; but it was reserved for Labillardière, Pelletier, and Caventon, to establish its alkaline property and its analogy to morphine. The last two chemists undertook the study of the quinquinas, and discovered them to possess two salifiable organic bases, which they named *cinchonine* and *quinine.* They exist together in all the plants of the genus quinquina; the *red kind* contains equal quantities of the two above-mentioned bases; the *gray* is mostly composed of the cinchonine; and the *yellow* of the quinine.

In order to obtain cinchonine, the gray quinquina reduced to powder is boiled in diluted muriatic acid; the liquor filtered, and again boiled; an excess of lime is added; it is filtered anew; the deposite is well washed, and treated with boiling alcohol, which dissolves all the cinchonine; it is then evaporated and crystallized. The salt is then purified by animal charcoal, and the base is extracted fron the new salt.

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* Cinchona, or Peruvian bark, is obtained from several species of the genus Cinchona; the French include them all under the general term, quinquinas.

Cinnabar. A name formerly given to the *Sulphuret of Mercury*. (See that word.)

Cistern Pneumatic. (*Cuve Pneumatique.*) *Pneumatic trough.* A vessel containing water, used for the purpose of collecting and transferring gases; it is sometimes called the *hydro-pneumatic* cistern. Another, called the *hydrargiro-pneumatic** cistern, contains mercury instead of water; this is used for collecting and transferring such gases as are soluble in water.

Citrates. Combinations of citric acid with salifiable bases. All the citrates are decomposed by fire, in the same manner as the tartrates. Among the known citrates, those of potash, soda, magnesia, strontian, ammonia, and iron, are soluble. The others are either wholly or almost insoluble, but dissolve perfectly in an excess of acid: they are all products of art. Those which are soluble are obtained directly; the others, by double decomposition. According to Berzelius, in the citrates, the oxygen of the oxide is to the quantity of the acid as 1 to 7·277. These salts are little used, except the citrate of lime, from which is extracted citric acid.

Coal. See *Charcoal*, *Animal*, also *Wood.*

Coals Mineral. Though bitumens, on account of their origin, are with more propriety classed among mineral substances, yet in chemical properties, they are more closely allied to the products of the vegetable kingdom. Like vegetable substances in general, they burn in the open air, and with a degree of brightness that surpasses even that of the resins. By distillation *per se*, they yield a weak acetic acid, an empyreumatic oil, some ammonia, and a considerable quantity of carburetted hydrogen gas, with occasionally a small proportion of carbonic acid and sulphuretted hydrogen. They are neither soluble in water nor in alcohol, and in the latter respect they differ from resin. There can be little doubt that they have been formed originally by the decomposition of vegetables.

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* From *hydrargyrus*, a name for mercury.

The bitumens have been divided into liquid and solid. Formerly it was supposed that the liquid bitumens had been derived, by a sort of natural distillation, from the solid; but Mr. Hatchett has rendered it more probable that the solid bitumens result from the consolidation of the fluid ones.

The bituminous substances are *Naphtha, Petroleum, Mineral Tar, Mineral Pitch, Asphaltum, Jet, Pit-Coal, Bituminous Wood, Turf, and Peat.* To these some writers have added *Amber* and the *Honey-Stone.*

Naphtha is a pungent, odoriferous, oily liquid, either colourless or of a pale brown tint, found upon the borders of the Caspian sea and in certain springs in Italy. It is considerably lighter than water, volatile, and highly inflammable. When pure, it appears to contain no oxygen, and hence is employed for the preservation of potassium and the other highly oxidable metals. It consists, according to Saussure, of

Carbon	87·21
Hydrogen	12·79
	100

This would indicate

6 atoms of carbon	36	88
5 " hydrogen	5	12
	41	100 H.

Petroleum has most of the properties of naphtha, but is less fluid, and darker coloured. In the countries where it abounds, it is employed for burning in lamps.

Mineral Tar appears to be petroleum further inspissated. It is more viscid, and of a deeper colour.

Maltha, or *Mineral Pitch*, is a soft inflammable substance, heavier than water, and may be considered as derived from the exsiccation of mineral tar.

Asphaltum is found abundantly on the shores of the Dead sea, in Albania, and in the island of Trinidad. Its colour is brown or black ; it is heavier than water, and readily soluble in naphtha.

Elastic Bitumen, or Mineral Caoutchouc, is found in the vicinity of Castleton, Eng. and at Southbury in the state of Connecticut. It is fusible and inflammable.

Mineral Adipocere, is a fatty matter found in the argillaceous iron ore of Merthyr ; it is fusible at about 160°, and inodorous when cold, but of a slight bitumous odour when heated, or after fusion.

The above substances are insoluble in water, and difficultly soluble in alcohol, with the exception of naphtha and petroleum, which are soluble in highly rectified alcohol.

Retinasphaltum is a substance which accompanies the Bovey Coal of Devonshire. It was first analyzed by Mr. Hatchett, who found it to consist of

55	Resin,
41	Asphaltum,
4	Earthy matter and loss.

Pit coal. There are three chemical varieties of this important substance. The first, or *brown coal*, retains some remains of the vegetables from which it has originated. When heated, it exhales a bituminous odour, and burns with a clear flame. It is generally of a tough consistency, and yields, according to Mr. Hatchett, a portion of unaltered vegetable extract, and resin.

The second variety, or *black coal*, is the ordinary fuel of Great Britain. It exhibits no traces of vegetable origin, and consists principally of bitumen and [illegible] in variable proportions. When exposed to heat, it swells, softens, and burns with a bright flame, leaving a small quantity of ashes. Many varieties, however, abound in earthy matter, and these produce copious cinders, and burn with a less intense heat. The products of the destructive distillation of this kind of coal give a residue of a hard sonorous charcoal termed *coke*. The third variety, *glance coal* or *anthracite*, consists almost entirely of charcoal and earthy matter.

It usually burns with little flame, and when submitted to distillation yields no tar, but a sort of carburetted hydrogen gas.

Peat and *Turf* consist principally of the remains of vegetables, having undergone comparatively little change. They also contain bituminous wood, branches and trunks of trees.

Mellite, or *Honey-Stone*, is a rare substance, formed in the brown coal of Thuringia and in Switzerland. It is of a honey yellow colour, crystallized in octoëdra, and when analyzed by Klaproth, was found to consist of alumina combined with a peculiar body which has been called the *mellitic acid*.*

Coal Gas. See *Carburetted Hydrogen.*

Cobalt. A solid metal, hard, brittle, magnetic, ductile with heat, closely grained; its colour is less shining than that of tin; its density appears to be 8·5384; it fuses at about 130° of Wedgwood's pyrometer. It has no action upon oxygen gas, except at a very elevated temperature, when it combines with this gas, and produces an oxide. Among the combustibles it has only been combined with sulphur, chlorine, phosphorus, and selenium. Sulphuric and hyro-chloric acids dissolve it, and hydrogen is disengaged; it has yet been alloyed with but a small number of metals. This metal was first obtained by Brandt. It is found sometimes in connection with ores of iron, copper, arsenic, &c. and separated by subjecting to a high temperature the ores which contain it.

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* This article on coal is extracted from Webster's Chemistry.

Cochineal. Was at first supposed to be a vegetable product, but naturalists soon discovered it to be an insect. It is brought from Mexico, where the insect lives upon different species of the Opuntia. The colouring extract from cochineal is called *carmine*.

Cohesion. See *Attraction*.

Colcothar. A name formerly given to the tritoxide of iron.

Cold. The privation of heat.

Colocyntin. The effects of colocynth are thought by Vauquelin to depend upon this substance.

Columbates. Combination of columbic acid with salifiable bases. These salts, the discovery of which is due to Hatchett, are scarcely known; that of potash, which has been most studied, has a sharp disagreeable taste, crystallizes like boracic acid; it is unalterable by the air, and little soluble in water. It is obtained by boiling an excess of columbic acid with caustic potash. The acids powerfully decompose the columbates, uniting with their bases, and precipitating the columbic acid. These substances are of little use.

Columbium. A metal of a dark gray colour, somewhat resembling iron; when reduced to powder it becomes almost brown. It is so hard as to scratch glass. It is not attacked by the acids. It combines with oxygen but in one single proportion, forming a white oxide, possessing acid properties, and therefore called *Columbic acid*. Columbium is obtained by heating columbic acid with charcoal to the highest temperature. The discovery of this metal, which is due to Hatchett, was made in analyzing a compound ore of iron and manganese from America. The discoverer named it in honour of Christopher Columbus (*Christophe Colomb.*) It is sometimes called *Columbium*.

Combination. See *Attraction.*

Combustible. A body which in its rapid union with others, causes a disengagement of light and heat.

Combustion.[*] Is the phenomenon which appears when oxygen unites with a combustible body. All the simple substances possess the property of uniting with it; that is, they are all susceptible of being burnt, and are therefore called combustible bodies. When a body is burnt, or combines with oxygen, which is the same thing, there is always a disengagement of caloric, and sometimes of light, but never of light without caloric. Before the time of the distinguished Lavoisier,[†] it was supposed that when a substance was burnt there was a disengagement of an insensible and impalpable principle, which the chemists of that age called *phlogiston.* When this principle was disengaged from a substance they supposed it ceased to be combustible, but when it was absorbed it became combustible. This theory was at variance with the well known fact that bodies increase in weight by combustion, but although erroneous, it still reflects great honour upon its author *Stahl.*

Lavoisier's theory of combustion, which followed that of Stahl, has in its turn its object; and at present it is asserted, that combustion depends upon the combination of opposite electricities. It is a fact that a piece of charcoal placed in a vacuum, and communicating with the two poles of the voltaic pile, soon becomes ignited. Combustion can then take place without oxygen, which fact must destroy the theory of Lavoisier, or at least modify it. For further details, see the Memoir of MM. Dulong and Petit. (*Annales de Chimie et de Physique.*)

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[*] Chlorine and iodine being now regarded as simple bodies analogous to oxygen, the latter can no longer be termed the *only* supporter of combustion.

[†] Here again the French chemists are at variance with the English as to the honour of discovery; the latter asserting that to Sir H. Davy belongs the merit which the former attribute to Lavoisier. See Dr. Ure's remarks under the article *Combustion.*

Combustible Substances. Simple combustible substances are those which have resisted all attempts at analysis, and which possess the property of combining with oxygen, forming either oxides or acids. In the present state of chemical knowledge we admit fifty-two, including fluorine. See the article *Elements*, where these different bodies are, after the order assigned them by Thénard, classed according to their greater or less affinity for oxygen. The following is the classification of Berzelius, in which the simple bodies are placed in such a manner, that each one is, in its electricity, positive with respect to the one which precedes, and negative to that which follows it.

BERZELIUS' CLASSIFICATION OF COMBUSTIBLE BODIES.

No. 1. Oxygen.
2. Sulphur.
3. Azote or Nitrogen.
4. Fluorine.
5. Phosphorus.
6. Selenium.
7. Arsenic.
8. Molybdenum.
9. Chromium.
10. Tungsten.
11. Boron.
12. Carbon.
13. Antimony.
14. Tellurium.
15. Tantalum.
16. Titanium.
17. Silicum.
18. Osmium.
19. Hydrogen.
20. Gold.
No. 21. Iridium.
22. Rhodium.
23. Platina.
24. Palladium.
25. Mercury.
26. Silver.
27. Copper.
28. Nickel.
29. Cobalt.
30. Bismuth.
31. Tin.
32. Zirconium.
33. Lead.
34. Cerium.
35. Uranium.
36. Iron.
37. Cadmium.
38. Zinc.
39. Manganese.
40. Aluminum.

41. Yttrium.	45. Strontium.
42. Glucinum.	46. Barium.
43. Magnesium.	47. Sodium.
44. Calcium.	48. Potassium.

It will be seen by this list that *chlorine* and *iodine* are omitted, which should have been placed directly after oxygen. Respecting *thorinium* and *lithium*, it is not yet known where these assumed metals should be placed. This method, which reflects great honour upon its author, has some inconveniences; for example, bismuth relative to cobalt, and silver relative to copper, must be as positive, as sulphur is relatively to oxygen. Unfortunately the observations on these points are comparatively few.

CONCENTRATION. Is an operation by the aid of which the particles of bodies are brought nearer, by expelling a superabundant substance. For example, sulphuric acid is concentrated by vaporizing a portion of the water which enfeebled it; a saline solution is concentrated in the same manner; vinegar becomes a jelly by concentration. Thus this process is effected in various ways.

COPPER. (*Cuivre.*) Is of a fine red colour, very malleable, very fusible, harder than silver, and the most sonorous of the metals. When rubbed it throws off a peculiar and nauseous odour. When melted its specific gravity is 7·7880. It fuses at 27° of Wedgewood's pyrometer. It is not volatile. Copper experiences no alteration from dry atmospheric air, but when in contact with damp air its surface becomes covered with the oxide, or the carbonate, according as it is most exposed to one or the other of these gases. When heated to redness copper oxidizes and is covered with brown scales. It can be alloyed with most of the others. The ancients gave it the name of Venus.

Copper has been known from the most remote antiquity, and next to iron is the most extensively used. It serves for a great number of common utensils, to cover ildings, to line vessels, &c. Combined with gold or ver, it forms our coin, and gold and silver ornaments; oyed with zinc it forms brass; combined with tin forms bronze, bell-metal, &c. It is found in nature in any different states. 1st, In the *native* state; 2d, As a *rbonate;* 3d, A *sulphuret;* 4th, An *oxide;* 5th, A *sul-* *ate;* 6th, An *arseniate;* 7th, A *phosphate.* It is very sy to obtain the metal by fusion from the native copper, e oxides, and carbonates; but it is not so with the sul- uret, which is sometimes for this purpose roasted enty times in succession.

Copper, Yellow. See *Alloys.*

Copperas. *Sulphate of iron.*

Corrosive Sublimate. The deuto-chloride of mer- ury, or oxy-muriate of mercury.

Coumarin. A peculiar odoriferous principle, derived om the *Coumarouna odorata* or Tonka bean; it is white, nd crystallizes in prisms—sometimes in needles. It issolves readily in ether and alcohol, but is scarcely so- uble in water. It was first noticed by Guibourt.

Cream of Tartar. See the *Acid tartrate of potash.*

Crucible. (*Creuset.*) A vessel of a conical or trian- ular form, used in chemistry to expose to the action of re, many solid substances. Crucibles are of stone, por- elain, iron, silver, platina, &c. Such as are manufac- ured at Hesse are generally preferred, as they are able support a very strong heat without breaking. These essels are usually furnished with a cover of the same aterial.

Crusts. The bony coverings of crabs, lobsters, &c. atchett found them to be composed of a cartilaginous ubstance like coagulated albumen, carbonate of lime, nd phosphate of lime. The great excess of the first dis- inguishes them from bones, while the quantity of the hird distinguishes them from shells. Egg shells and snail shells belong to crusts in composition, but the animal matter is in smaller quantity.

Cryophorus. The *frost-bearer* or carrier of cold, invented by Dr. Wollaston, to demonstrate the relation between evaporation at low temperature, and the production of cold.

Crystallization. A name given to the phenomena which appear when similar particles of bodies unite on account of their cohesive attraction, producing a regular solid, called a *crystal.* In order that crystallization may be effected in a regular manner, much precaution is necessary. In the first place the solution must not be too much concentrated, or on cooling, it will deposite too great a quantity of the substance which it contains. This inconvenience is obviated by considering the solubility of the salts either by heat or cold. When however a salt is deliquescent, and of course very soluble by cold, it can be crystallized only by evaporating the liquor almost to dryness. In order to obtain crystals of much volume, it is necessary to employ a certain quantity of saline matter. The solution should be placed where it will stand without being in the least agitated; and vessels must not be used which are liable to be attacked by the salts. In order to procure a fine crystallization, a certain quantity of salt must be dissolved; the solution if not very limpid, must be filtered, then suitably evaporated, and carefully set aside. In the space of 24 hours the crystallization takes place; the liquor is decanted by a gentle inclination of the vessel containing it—this water is called the *mother water* (*l'eau mère.*) The crystals are then left to drain, and should in many cases be preserved from contact with the air.

M. Leblanc has published a process, by the aid of which, he obtained very large crystals. It consists in dissolving with heat a sufficient quantity of salt; the liquor crystallizes on cooling, the mother water is decanted, turned into a flat-bottomed vessel, and left to itself at the ordinary temperature. When isolated crystals are formed, the most regular are selected and put into other flat-bottomed vessels with the same mother water; they are turned every day, that they may enlarge equally on all parts of their surface, and the solution is from time to time changed. When of a certain size, the crystals are placed separately in a peculiar kind of vessel, where their enlargement is terminated.

Berzelius remarks that crystals, by whatever process they may have been obtained, almost always contain a certain quantity of water, which exists either in a free state, or in a state of combination; the former he calls the *water of interposition*, and the latter the *water of crystallization*. There are few salts which contain the water of interposition; they are those which decrepitate on heating. All the deliquescent and efflorescent salts possess the water of crystallization. Some solutions will not crystallize regularly even at the highest degree of concentration; but if agitated, they deposite a great quantity of confused crystals. This phenomenon is owing to the agitation, which changing the arrangement of the particles, puts them into such a situation, that the surfaces which ought gradually to meet in the formation of a crystal, being thus thrown together, are suddenly forced to unite. The nitrate of silver furnishes an example of this kind. Bodies which are insoluble in water, may be crystallized by fusion or sublimation, for example, sulphur; bismuth, &c., being melted in a crucible and left to cool, form a crust on the surface, which being penetrated in order to decant the liquid part, perfectly formed crystals are obtained.

Crystals of Venus. Acetate of copper.

Cucurbit. The lower part of an alembic. (See this word.)

Cupellation. This term signifies the refining of metals with lead upon the cupel. The *cupel* is a shallow earthen vessel, somewhat resembling a cup.

Cyanides. (*Cyanures.*) Prussiates. Combinations of cyanogen with combustible bodies; in many respects they resemble chlorides. Some chemists, with Gay-Lussac, think that the alkaline cyanides neither dissolve in water nor change their nature; others, on the contrary, maintain that the water is decomposed, changing them to hydro-cyanates. We shall, without attempting to decide upon the comparative merits of these theories, proceed to a description of the cyanides.

Cyanide of Iodine. (*Cyanure d'Iode.*) Prussiate of Iodine. White, in long and very light needles, of a strong odour, very irritating to the eyes. It has neither action upon litmus, nor curcuma paper; chlorine does not act upon this compound; the solutions of silver are not affected by it. The cyanide of iodine is obtained by heating in a phial two parts of the cyanide of mercury, and one part of iodine; the whole should be perfectly dry and well mixed. Action soon takes place, and the result is, the formation of a proto-iode of mercury, and a very volatile cyanide of iodine, which is easily collected by inclining the phial so that the vapour can pass into a flask with a large opening. This new compound was recently discovered by M. Serullas.

Cyanide of Mercury. (*Cyanure de Mercure.*) Prussiate of Mercury. Colourless, of a decided metallic taste, crystallizes in quadrangular prisms; it has no action upon litmus. Submitted to the action of fire, in close vessels, it decomposes into cyanogen and metallic mercury; a little of the cyanide sublimes, and a little of the cyanogen is reduced to its elements. Heated with one third of sulphur, one part of the cyanogen is disengaged, and the result is a sulpho-cyanide of mercury. The cyanide of mercury is more soluble in hot than cold water. Caustic potash dissolves it, forming a triple compound susceptible of crystallization. Most of the hydracids decompose it; the result is hydro-cyanic (prussic) acid, which is disengaged, and a chloride, an iodide of mercury, &c. The cyanide of mercury in solution in water dissolves a certain quantity of the oxide of mercury, forming a new compound, which crystallizes in little clusters. In order to prepare the cyanide of mercury, one part of the deutoxide of mercury is boiled with two parts of prussian blue, and eight parts of water: The mixture is at first blue, and then yellow; the precipitate is filtered and washed, the waters of the washing are united, and the liquor evaporated; on cooling, it produces crystals of the cyanide. These crystals are coloured by the oxide of iron. In order to obtain the neutral cyanide, hydro-cyanic acid must be added to saturate the excess of mercury; it is then again evaporated, and crystallized. Its composition in weight appears to be 100 of mercury, and 26·086 of cyanogen.

Cyanide of Potassium. (*Cyanure de Potassium.*) Prussiate of potash. A yellowish crystalline compound, alkaline and very soluble in water. It is obtained by the action of cyanogen upon potassium, by the aid of heat, in a little bell-glass inverted over mercury. The absorption is rapid, with an elimination of light and heat. This substance is without use. It may also be obtained by saturating pure potash with hydro-cyanic acid; analogous to this cyanide are those of soda, barytes, strontian, and lime, which are soluble and always alkaline. All the acids, even carbonic acid, decompose them. With the salts of the last four sections (see metals) they form cyanides of variable colours, which are almost all insoluble.

Cyanide of Silver. (*Cyanure d'Argent.*) Prussiate of Silver. White, insoluble, decomposable by fire. It is obtained by pouring a solution of the cyanide of potassium into a solution of the nitrate of silver.

Cyano-Ferrures. See *Ferro-Cyanates.*

Cyanogen. (From *kuanos* blue, and *ginomai* I produce. The producer of blue.) *Prussine. Prussic gas.* Is a permanent, inflammable gas, of a sharp and lively odour; its specific gravity is greater than that of water. It reddens litmus, but where the paper is heated, the blue re-appears. This substance supports a high temperature without decomposing. Faraday, by subjecting it to a high degree of cold and pressure, succeeded in bringing it to a liquid state. A taper plunged in this gas burns with a purple flame. Water, sulphuric ether, and essence of turpentine dissolve four times their volume, and alcohol twenty times its volume of it. Cyanogen is obtained by decomposing by fire the perfectly dry neutral cyanide of mercury. For this purpose the cyanide is introduced into a small well dried retort, to which is fitted a tube that passes under a bell-glass full of mercury; being gently heated, the cyanogen disengages, and passes into the bell-glass, while the mercury condenses in the tube. The science of chemistry owes the knowledge of this substance to Gay-Lussac, who discovered it in analyzing what was then called *prussiate of mercury*, now the cyanide of mercury. Cyanogen consists of two volumes of the vapour of carbon, and one volume of nitrogen, condensed into a single volume.

Cyano-Sulphuret. A new compound, obtained by heating in a phial a mixture of sulphur, the double cyanide of potassium, and of iron. The cyanide of iron decomposes; the result is a sulphuret of iron, and sulphuret of carbon, and an elimination of nitrogen. The other double cyanides exhibit similar phenomena. (See "*Traité de Chimie,*" *de M. Thénard.*)

Cynopia. An alkali recently discovered by Ficinus of Dresden. He obtained it in rhombic prisms, from the *Æthusa cynapium*, a species of hemlock.

Cytesine. A name proposed by Chevalier and Lassaigne to designate a substance which they extracted from the seeds of the *Cytesus laburnum*. It absorbs powerfully humidity from the atmosphere, and has an energetic action upon the animal economy. (See Journal of Pharmacy, Vol. IV. p. 340.)

D

Dalhine. A white pulverulent matter, very compact; it was discovered in the tubercles of the *Dahlia* by M. Payen. This substance resembles starch; it is however little soluble in cold water; alcohol precipitates it, but this is not the case with iodine, chlorine, the acetate of lead, hydro-chlorate (muriate) of platina, proto-sulphate and trito-sulphate of iron, the nitrate of silver, the proto-nitrate of mercury, the sulphate of copper; these different substances do not precipitate it. Sulphuric acid transforms it into sugar.

Daphnine. This substance was discovered by Vauquelin, in the bark of the *Daphne*. It is in prismatic fasicles, colourless, transparent, shining, soluble in warm water, alcohol and ether. Nitric acid transforms it into oxalic acid; the acetate of lead does not precipitate it.

Daturine. This substance was discovered by Brande in the seeds of the *Datura stramonium ;* it is insoluble in water, soluble in hot alcohol. The salts which it forms with acids are dissolved by water.

Decantation. The act of pouring off the clearer part of a fluid by gently inclining the vessel after the grosser parts have been suffered to subside.

Decoction. The operation of boiling. This term is likewise used to denote the fluid itself, which has been made to take up certain soluble principles by boiling. Thus we say a decoction of the bark or other parts of vegetables, &c.

Decomposition. A body is said to be decomposed when by any cause whatever its elements disunite, either to form new combinations, or to remain isolated. This operation is of great importance in chemistry, as it is very rare that one combination is formed but by the destruction of another. Decomposition differs from analysis in this respect; that in the latter the products are carefully collected, and usually an account is kept of their quantity. The analyses, anciently made, were in reality but decompositions, giving for results, air, earth and water, which for a time were supposed to be the only simple substances.

Decrepitation. The crackling noise made by several salts when suddenly heated, accompanied by a violent exfoliation of their particles.

Deflagration. This word is used by electricians and chemists to denote that kind of combustion which takes place in metallic wires or leaves, when subjected to galvanic or electric discharges.

Deliquescence. The property which certain substances possess of attracting humidity from the atmosphere and other surrounding bodies, of becoming saturated, and even passing from the solid to the fluid state. Many salts and acids possess this property; such substances either crystallize with difficulty or not at all; they are all soluble in water, and usually so in alcohol; in order to keep them dry they should be preserved in close vessels.

Delphia. (*Delphine.*) A white powder, very fine, inodorous, little soluble in water, dissolving easily in alcohol and ether. When thrown upon burning coals, it melts, burns without any residue, diffusing a thick white vapour. MM. Lassaigne and Feneulle discovered this new alkaline base in the seeds of the larkspur (*Delphinium staphysagria.*) It appears to exist but in the cotyledons, where it is combined with malic acid. It is obtained by separating by ether the oily matter of the seeds, boiling them in distilled water, adding a little magnesia and treating it with boiling alcohol. The delphia is in time deposited.

Demi-Metals. The ancients thus named the brittle metals because they deemed them less perfect than the others.

Density. It is easy to perceive that bodies of the same volume differ in weight; this difference is often so great as to be recognised on lifting substances with the hand, but there are means for ascertaining with accuracy the specific gravity of bodies.

Among gases, atmospheric air is chosen for a term of comparison, and a unit of weight.. In order to obtain the density of any gas, a suitable vessel of a known capacity must be weighed, at first empty, then filled with dry gas and again weighed; subtracting the first weight from the second, the difference gives the weight of the volume of gas contained in the vessel. Observations should be made relative to the temperature and the pressure under which the weight is ascertained. (See *Analysis.*) Distilled water is taken as the unit for liquid and solid bodies. In order to ascertain the specific gravity of any liquid, a vessel is selected to serve for the common measure, this is very exactly weighed, then filled with distilled water and again weighed; it is then emptied, carefully dried, and filled with the liquid whose density is to be ascertained; this is weighed, and the weight of the two bodies under the same volume is then found. But if the body is solid, the following is the most common process although its specific gravity may in most cases be obtained nearly in the same manner. As it is demonstrated that a body plunged into a liquid, loses precisely the same quantity of its weight as the weight of the volume which it displaces, the body is weighed in the air, then weighed in the water by means of a thread attached to the edge of the balance. The difference of this weight with the first, shows the weight of a volume equal to its own. If the body weighed was susceptible of imbibing water, it would be necessary to weigh it again after taking it out of the water, and to add to the weight found displaced by the liquid, that of the liquid imbibed. If the body was soluble in water, some other liquid must then be used, and necessary corrections made in the calculation.

Deoxigenation. Depriving of oxygen.

Dephlegmation. Any method by which bodies are deprived of water.

Dephlogisticated. A term of the old chemists, implying deprived of phlogiston, or the inflammable principle, and nearly synonymous with what is now expressed by oxygenated or oxidized.

Dephlogisticated Air. The same with oxygen gas.

Desiccation. Drying up of moisture.

Destructive Distillation. When organized substances, or their products are exposed to distillation until the whole has undergone all that the furnace can effect, the process is called destructive distillation.

Detonation. A sudden combustion or explosion.

Deuto-Chlorures. See *Chlorides* (*Deuto.*)

Deut-Oxides. See *Oxides* (*Deuto.*)

Deuto-Phosphurets. See *Phosphurets* (*Deuto.*)

Deuto-Sulphurets. See *Sulphurets* (*Deuto.*)

Dew. The moisture insensibly deposited from the atmosphere on the surface of the earth.

Diamond. See *Carbon.*

Digester. An instrument invented to prevent the loss of heat by evaporation.

Digestion. The slow action of a solvent upon any substance.

Dilatation. See *Caloric.*

Dippel's Animal Oil. An oily matter obtained by the decomposition of horns in a retort.

Dissolution. When two bodies being in contact, the one disappears in the other without affecting its transparency, this is a dissolution or a solution. It is a *dissolution*, when the body dissolved has changed its nature and cannot be cbtained in its original state by a careful evaporation; it is a *solution*, when by evaporation the body which was dissolved can be so obtained. For example, a *solution* of sugar in water, and a *dissolution* of mercury in nitric acid.*

Distillation. (From *distillo*, to drop little by little.) It is the refining of a volatile substance by means of evaporation. Distillation is simple or complex: it is simple when a volatile matter is mixed with such as are not volatile, or which volatilize with difficulty; it is complex when the distilled matter contains many volatile principles, but the one which is to be obtained is the most volatile of all. There are in distillation two operations of an opposite nature, vaporization and condensation.

The distillatory vessels are either *alembics* or *retorts*; the former consists of an inferior vessel called a *cucurbit*, designed to contain the matter to be examined, nad having an upper part fixed to it, called the *capital* or *head*. In this last the vapours are condensed by the air, or by the assistance of cold water surrounding the head, and contained in a vessel called the *refrigeratory*. From the lower part of the capital proceeds a tube called the nose, beak, or spout, through which the vapours after condensation are by a proper figure of the capital made to flow into a vessel called the *receiver*, which is usually spherical. These receivers have different names according to their figure, being called balloons, matrasses, &c. In chemistry distillation is mostly performed in retorts. This the ancients called distillation *per latus;* they called distillation *per ascensum* that which is practised in the common distilling apparatus; and *per descensum* a kind of distillation in which the vapours were forced to descend.

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* The distinction made by the French chemists between these two words, seems very proper; it does not, however, appear to be noticed by English writers.

Ductility. The property possessed by certain metals of being drawn out into very fine threads or wire, or in very thin plates, always preserving a certain solidity. The ancient chemists called those which did not possess this property half (*demi*) metals.

E.

Earths. (*Terres.*) This name was formerly given, and is now applied to oxides which are generally very abundant in nature, constituting the greatest part of the globe. These oxides are found isolated, or in a mixed state, scattered over the face of the earth; but they are more frequently united in a manner to form combinations in determinate proportions, thus constituting the greater part of stones. The earths, until recently, have been regarded as metallic oxides; it is certain that lime, barytes, strontian, &c., are combinations of oxygen with a metal; but Berzelius has lately ascertained that silex and zirconium are non-metallic oxides, and has thus shown that chemists cannot be positive as to the nature of those that have not been decomposed. (See *Oxides.*)

Ebullition. (From *ebullio*, to bubble up.) It is the passage of a liquid to the state of vapour. This change takes place at different temperatures in different bodies, modified also by the degree of external pressure. Thus water, when pure, boils at 212°, at the pressure of 76 centimètres. But it is only the surface of the water which offers this temperature; the water at the bottom of the vessel, supporting besides the pressure of the atmosphere that of the superior liquid, requires a much higher temperature to procure ebullition.

Echini. Calcareous petrifactions of the *echinus*, or sea hedgehog.

Effervescence. A species of ebullition produced in a liquid by the sudden disengagement of a gaseous body, but which is not the vapour of the liquid from which it has escaped; in this case it would simply be boiling.

Efflorescence. A property of certain bodies to yield to atmospheric air, and other gases, part and even the whole of the water which they contain. They are, notwithstanding, very soluble, for example *sulphate of soda* (Glauber's salts.)

Elaine. (*Oléine.*) Is a substance resembling oil; it is liquid at the ordinary temperature, has a sweet insipid taste, is lighter than water, and has an action upon vegetable colours. At some degrees below the freezing point it congeals and crystallizes in needles; it is volatile without decomposition in a vacuum; heated in the air, it burns like the oils; 100 parts of boiling alcohol of a density of 0·816 dissolves 3·2 of elaine. It saponifies with potash, and is decomposed into oleic and margaritic acids; it furnishes more glycerine than stearine does. According to Chevreul, elaine is composed of 79·030 of carbon, 11·422 of hydrogen, and 9·548 of oxygen. It exists in the fat of pork, goose, mutton, human fat, &c. It is obtained by dissolving any one of these kinds of fat in boiling alcohol; on cooling, the stearine separates; by evaporating the alcohol, elaine is obtained in the greatest purity.

Electricity. (*Electricité.*) A property which certain bodies possess when rubbed, heated, or otherwise excited, of attracting remote bodies, and frequently emittin sparks or streams of light. The ancients first observed this property in amber, which they called *electrum*; and hence arose the word electricity. (The subject of electricity more properly belongs to the department of natural philosophy than chemistry.)

Electron. Greek name of *amber*; from whence the term electricity, this phenomenon being first observed in amber.

Elements. (*Elemens.*) These are simple bodies which by their different combinations form all possible compounds. The ancient chemists believed that there were but four elements, *earth*, *fire*, *air*, and *water*. We now acknowledge a much greater number, but our elements may hereafter meet with a fate similar to those of the ancients; they may be decomposed, and their number reduced. Notwithstanding the probability of the conjectures, it would be absurd at present not to regard as simple those bodies which resist all attempts of chemists at decomposition. The elements are usually divided into three classes: the first contains *oxygen*; the second comprehends *combustible bodies, non-metallic.* When ranked according to their affinity for oxygen, they are placed as follows:

Hydrogen.
Boron.
Carbon.
Phosphorus.
Sulphur.
Selenium.
Chlorine.
Iodine.
Nitrogen.

The third class, which is the most numerous, contains all the *metals*. In arranging them according to their affinity for oxygen, they appear as follows:

Silicum.
Zirconium.
Thorinum.
Aluminum.
Yttrium.
Glucinum.
Magnesium.
Calcium.
Strontium.
Barium.

Lithium.
Potassium.
Sodium.
Manganese.
Zinc.
Iron.
Tin.
Cadmium.
Arsenic.
Molybdenum.
Chromium.
Tungsten.
Columbium.
Antimony.
Uranium.
Cerium.
Cobalt.
Titanium.
Bismuth.
Copper.
Tellurium.
Nickel.
Lead.
Mercury.
Osmium.
Silver.
Palladium.
Rhodium.
Platinum.
Gold.
Iridium.

The unknown radical of fluoric acid, (*fluorine*) may still be regarded as a simple body, also *caloric*, *light*, the *electric fluid*, and the *magnetic fluid*. In addition to the elements above named, are two of recent discovery, *bromine* and *pluranium*.

Eliquation. An operation by means of which a more fusible substance is separated from another which is less fusible. It consists in the application of a degree of heat sufficient to fuse the former, but not the latter.

Elutriation. (From *elutrio*, to cleanse.) This word is used by chemists to denote the process of washing, which carries off the lighter earthy parts, while the heavier metallic parts subside to the bottom.

Emetin. (*Emétine.*) A salifiable, vegetable base, which when pure is white or yellow, pulverulent, fusible at 122°, changing colour in the air. It is very little soluble in water, ether, and the oils, but easily dissolves in alcohol. It forms with acids uncrystallizable salts. Its solution is precipitated white by nutgalls; but it is not changed by the acetate of lead, or by oxalates and tartrates based upon potash and soda; it may thus be distinguished from quinine, which precipitates with those bodies. This substance was discovered by Pelletier, in the different species of the *ipecacuanha.* It is obtained by treating the barks of the roots with ether, in order to separate an oily matter; afterwards treating it with boiling alcohol, which on cooling deposites the emetin with a little oily matter, wax, and gallic acid. These substances can be separated only by treating the deposite successively with water, magnesia, and rectified alcohol. Emetin is employed in medicine.

Emetic Tartar. (*Antimonium tartarizatum.*) It is obtained by boiling the fusible oxide of antimony with the super-tartrate of potassa; the excess of tartaric acid dissolves the oxide, and a triple salt is obtained by crystallization.

Emplatre. A name given to a mixture of the margarate and oleate of lead. See *Margarates*, *Oleates*, and *Saponification*.

Eprouvettes. These are small bell-glasses, or large tubes closed at one end, chiefly used for collecting gas and assaying.

Equivalents Chemical. See *Numbers Proportional.*

Essences. Several of the volatile or essential oils are called essences by perfumers.

Ethal. A peculiar oily substance which Chevreul discovered in treating spermaceti (*cetine*) with potash. As its composition is analogous to those of alcohol and ether, it is named from the first two syllables *eth* and *al*. It is a solid matter, without colour or odour, insipid, half transparent, fusible at 122°, and volatilizing at a little higher temperature. It resembles cholesterine in not being acted upon by alkalies, but differs from it in composition, not giving off cholesteric acid when treated with nitric acid.

Ether. The generic name of *ether* is given to products which result from the action of acids upon alcohol. These products being various, the species is designated by the name of the acid used in obtaining it; as sulphuric ether, acetic, nitric, &c. The ethers have been divided into *three* sections, according to the elements which compose them. The 1st contains those which are formed of oxygen, hydrogen, and carbon; the 2d contains those which are formed of alcohol and the acid employed in its preparation; the 3d section contains those produced by the combination of deuto-carburetted hydrogen with the acid employed to make them. In the first division are,

Sulphuric
Phosphoric
Arsenic } Ethers.
Fluo-boric

In the second division are,

Hydro-chloric (Muriatic) } Ethers.
Hydriodic

In the third, which is the most numerous division, are,

Nitric
Acetic
Benzoic
Oxalic } Ethers.
Gallic
Tartaric
Citric

Ether Acetic. (*Ether Acétique.*) A colourless liquid, of an agreeable odour, whose specific gravity is from 0·866 to 7. It boils at 160°, under a pressure of 0·75. It inflames on the approach of an ignited body and produces acetic acid. Water dissolves nearly one seventh of its weight; thus dissolved, potash decomposes it by taking its acid. It dissolves many fat substances, and is itself dissolved in alcohol. It is employed in medicine. It is obtained by distilling to dryness 3 parts of alcohol, at 104°, and 2 parts of concentrated sulphuric acid. The product is mixed with one fifth of its weight of concentrated sulphuric acid and distilled anew, until a quantity of ether is obtained equal to that of the alcohol employed.

ETHER ARSENIC. See *Ether Sulphuric.*

ETHER BENZOIC. A colourless liquid, of an oily appearance, a sharp taste, having a density greater than water. It is soluble in alcohol from which it is precipitated by water, which only dissolves it when hot. It boils at about 212°. Potash decomposes it by abstracting its acid. It is obtained by heating in a retort a mixture of two parts of benzoic acid, four parts of alcohol, and one part of liquid concentrated hydro-chloric acid. The greater part of the ether remains at the bottom of the retort. It is then covered with alcohol, water, hydro-chloric and benzoic acids. This ether is dissolved in warm water. On cooling it is deposited in a solid state, combined with a little benzoic acid; the excess of acid is abstracted by a small quantity of alkali. It is not used.

ETHER CHROMO-SULPHURIC. The combination of sulphuric acid with chromic acid, produces by contact with alcohol an ether resembling the sulphuric.

ETHER CITRIC. Presents similar properties to the benzoic. It is obtained in nearly the same manner, except that sulphuric acid is employed instead of hydro-chloric, in order to facilitate the action of the vegetable acid upon the alcohol.

ETHER FLUO-BORIC. Differs not from sulphuric ether, except that fluo-boric acid is employed in its preparation. See *Ether Sulphuric.*

ETHER HYDRIODIC. Liquid, transparent, of an odour resembling that of other ethers; its density is 1·9206 at

72°. After a few days it becomes rose-coloured, owing to a small quantity of iodine which is set free. Potash destroys this tint. This ether boils at 156° under a pressure of 76 centimètres. It produces purple vapours when poured drop by drop upon burning charcoal; but it does not inflame on the approach of a burning body. Potassium, chlorine, nitric and sulphurous acids, do not instantly act upon it. It is obtained by mixing in volume 2 parts of alcohol and 1 part of coloured hydriodic acid having 1·7 of density, distilling the mixture in a sand-bath, and diluting with water the product which is collected in the receiver. The ether is precipitated under the form of little milky globules, which by their union form a transparent liquid. The discovery of its properties is due to Gay-Lussac.

Ether Hydro-Chloric. Muriatic ether. At the temperature of 52° and over, it is a colourless gas, of a very strong odour, taste a little sugared; its specific gravity is 2·219, that of the air being 1. Below 52° it is liquid; its density compared to that of water is 0·874 at 41°. It inflames very easily on the approach of an ignited body, and burns with a green flame. Water dissolves a volume of it equal to its own at 55°; it dissolves in alcohol. Most of the acids decompose it with heat; the alkalies decompose it after a few days. In order to obtain this ether, a mixture of equal parts of liquid hydrochloric acid at 77° and alcohol at 104° is introduced into a glass retort; this, being fitted to Woulfe's apparatus, is placed upon a sand-bath. In the first flask is put water at about 60°; the other flasks are left empty. The distilling vessels should be long in proportion to their breadth and surrounded with ice. At a gentle heat the distillation commences; the gas of ether divests itself of the superfluous acid and alcohol in the water of the first flask, and is condensed in the others. It is employed in medicine. It is composed of one volume of hydro-chloric acid gas and one volume of bi-carburetted hydrogen, condensed into one volume. Its discovery and the study of its properties are due to M. Thenard.

Ether Malic. Differs but little from the citric and benzoic ethers. (See these words.)

Ether Nitric. A liquid of a yellowish white, of a very strong odour, a sharp burning taste, heavier than alcohol, but less so than water. It boils at 70°, and inflames very easily. Water dissolves a small quantity of it; but not without decomposing a still greater part, and vaporizing more. If this water is saturated by potash, there will be a formation of the hypo-nitrate of potash. It is very difficult to preserve this ether without alteration; the potash however is not instantly decomposed. This substance is employed in medicine; it is obtained by distilling a mixture of equal parts in weight of concentrated alcohol and common nitric acid. The retort communicates with five flasks of Woulfe's apparatus; the first flask is empty, the four others are filled with salt water. These flasks are surrounded with a refrigerating mixture. The retort must be carefully heated, and whenever any signs of ebullition appear, the fire is taken away and the retort wet with cold water, but not so cold as to break it; when the ebullition ceases, the operation is terminated. This ether appears to be composed of alcohol, and hypo-nitric acid, or rather of nitric acid, and carburetted hydrogen.

Ether Oxalic. Differs little from citric acid. (See this word.)

Ether Phosphoric. See *Ether Sulphuric.*

Ether Sulphuric. (*Ether Sulfurique.*) It has been long known and is much used particularly in medicine and in the laboratories of chemists. It is a colourless liquid, of a strong and sweet odour, of a hot and sharp taste; according to Gay-Lussac, it does not transmit the electric fluid; it strongly refracts the light, is perfectly limpid and very fluid. Its specific* gravity is 0·71192 at 75°; it boils at 95°; and the density of its vapour according to the same chemist is 2·586, atmospheric air being taken for unity. It solidifies at —46°; it inflames with the greatest facility; can dissolve a small quantity of sulphur and phosphorus, also camphor, india rubber, (caoutchouc,) most fat substances, many salifiable organic bases, and the fixed and volatile oils. It dissolves a small quantity of alcohol, and mixes with it in all proportions.

In order to obtain sulphuric ether, put 6 parts of concentrated sulphuric acid and 5 parts of alcohol into a tubulated glass retort placed upon the sand-bath; the alcohol should be first put into the retort, and the acid added gradually; a glass tube enclosed within another tube of tin is fitted to the retort, and to a receiver usually furnished with a stop-cock and a bent tube for passing off the gas; the unoccupied space in the tin tube is filled with cold water, which flows out as fast as it heats at an opening in the upper part of it; the heat must be applied gradually; in a short time 5 other parts of alcohol must be poured into the retort; the operation is continued until white vapours may be perceived in the retort; as after this, nothing is obtained but sulphurous gas, a peculiar liquid called the sweet oil of wine, carburetted hydrogen and carbonic acid gases. The ether thus obtained requires to be rectified; for this purpose it is brought in contact with $\frac{1}{15}$ of its weight of caustic potash, which absorbs the sulphurous acid and the sweet oil of wine. It is decanted, and agitated with water, which unites with any alcohol that may be in the ether; and as this ether has the property of dissolving a small quantity of water.

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* Dr. Ure states that it boils at 98°, he referring to the mean annual temperature of England, while the French chemists state its boiling point at 3° less: this difference is owing to the pressure of the atmosphere in France being less than in England, on account of the higher temperature of the former country.

this latter fluid is abstracted by gently distilling the ether with the chloride of calcium.

It was long believed that sulphuric acid transformed alcohol into ether by taking from it a certain quantity of water; and the composition of ether seemed entirely to favour this theory; at present the decomposition of sulphuric acid is admitted, and also that alcohol consists of two parts; that the one, leaving the water, changes into ether; (or which is the same thing into hydrogen and oxygen in proportion to constitute ether;) that the hydrogen carries the sulphuric acid to the state of hypo-sulphuric acid; and the oxygen, by its union with the other portion of the alcohol, forms a peculiar vegetable matter, which combines with the hypo-sulphuric acid. Ether is composed of 2 volumes of bi-carburetted hydrogen and 1 volume of the vapour of water; if we add 1 volume of the vapour of water, we shall have the composition of alcohol. Phosphoric, arsenic, and fluo-boric ethers offer the same characters, and are obtained in the same manner, except that alcohol in these is added in small portions by means of a tunnel which passes to the bottom of the retort.

Ether Tartaric. Tartaric acid can combine with alcohol through the medium of sulphuric acid; the result is a sirupous compound, which forms with potash an abundant precipitate of acid tartrate; if this is afterwards treated with alcohol, a peculiar brown and bitter matter is obtained, soluble in water and alcohol, and which precipitates the hydro-chlorate of barytes, but not the hydro-chlorate of lime.

Ethiops of Mercury. See *Sulphuret of Mercury.*

Ethiops Martial. See *Oxide of Iron* (*Deuto.*)

Ethiops Mineral. See *Sulphuret of Mercury.*

Euchlorine. See *Oxide of Chlorine.*

Eudiometer. An instrument employed in the analysis of gases, and particularly of atmospheric air. It consists of a glass tube, open at one end, and closed at the other by a stopper of metal with a little wire, surmounted with a metallic ball, which serves to receive and transmit the electric spark. Within the tube is a little spiral wire of metal which is also terminated by a ball. This instrument is varied in many ways.

Evaporation. A chemical operation usually performed by applying heat to any compound substance in order to dispel the volatile parts. It differs from distillation in its object, which chiefly consists in preserving the more fixed matter, while the volatile substances are dissipated and lost, and the vessels are accordingly different; evaporation being commonly made in open shallow vessels, and distillation in vessels nearly closed from the external air. A current of air, as well as heat, hastens evaporation.

Extractive. (*Extractif.*) A principle admitted in chemistry, but which has not yet been isolated. It is supposed to exist in infusions and decoctions of vegetable substances, to have the property of forming combinations with many metallic oxides, of being soluble in water and alcohol, of being able to absorb oxygen, and then to lose its solubility; it is thought to contain nitrogen.

Extract of Saturn. See *Acetate of Lead* (*Sub.*)

F.

Farina. Vegetable flour.

Fat. (*Graisse.*) Is found in most animals; its consistence varies from an oily substance to a solid, according to the animal, and the part which furnishes it. The colour and odour are variable; it is usually solid and white in the ruminating animals, soft and of a strong odour in the carnivorous. According to Chevreul, fat is formed of *elaine* and *stearine* in different proportions, thus producing degrees of consistence so various. It contains also a colouring matter. Fat substances have usually sweetish insipid taste; they are lighter than water. Submitted to the action of fire in distilling vessels, fat furnishes a little water, carbonic, acetic, and sebacic acids, a great quantity of carburetted hydrogen, and a little of oily matter. A small quantity of charcoal which is easily incinerated remains. Alcohol, sulphur, and phosphorus, possess the property of dissolving it. Exposed to the air it assumes a reddish hue by absorbing a portion of oxygen.

Fecula. See *Starch.*

Fecula Green. See *Chlorophylle.*

Fermentation. A spontaneous movement which takes place in substances; their elements disunite, combine in other proportions, and give rise to compounds of which no trace before existed. The processes of fermentation are numerous, as *saccharine*, which affords sugars; *vinous*, *spirituous*, or *alcoholic*, where the sugar is changed into ardent spirit; *acid*, in which *acetic* acid is the principal result; *putrid* or putrifying, which produces volatile alkali, and gives a fetid mass.

Fermentation Acid. This fermentation takes place when a spirituous or vinous liquor gives rise to a certain quantity of acetic acid. The production of this acid below 50°, proceeds very slowly. The most favourable temperature is from 59° to 86°. The liquor slightly heated, disengages carbonic acid, and produces a thickish matter, which is formed by the deposite of a great quantity of little filaments, which disturb the transparency of the liquid. It appears that the presence of air or oxygen is not indispensable to the formation of acid; but it forms in a quantity greater in proportion to the alcohol contained in the liquor. It appears then that the acid results from a change in the proportions of the constituent principles of the alcohol. When the liquor is exposed to the air, it may be supposed that the alcohol yielding carbon and hydrogen to the oxygen of the air, passes to the acid state, but this fact is not proved; and when the liquor becomes acid without having been in contact with the air, it is still more difficult to account for the change by a satisfactory theory.

Fermentation Alcoholic. *Vinous Fermentation.* This takes place when a liquor containing sugar and a small quantity of yest is exposed to a certain temperature, say from 68° to 86°. The liquor soon begins to exhibit marks of action; bubbles of carbonic acid attracting around them little parcels of the yest, form a froth upon the surface; the liquor soon deposites the interposed substances which disturbed it, and becomes clear. The sugar having disappeared, it seems probable that it has been transformed into alcohol and carbonic acid; it is thought that this effect is produced by the yest abstracting from the sugar, a little oxygen; little can be taken from it, for but a very small portion is decomposed. The phenomena might however be referred to a change of the proportions constituting sugar, and its elements combining in other proportions. According to Gay-Lussac, sugar may be transformed into alcohol, by taking from the former 1 volume of oxygen gas, and 1 volume of the vapour of carbon, constituting by their union 1 volume of carbonic acid gas; thus supposing nothing to be lost, 100 parts of sugar would give 51·34 of alcohol, and 48·66 of carbonic acid. The yest in this case would not have sensibly absorbed oxygen.

Fermentation Putrid. While life remains in organized beings, the elements of which they are composed remain united according to the laws of the vital principle, which are often contrary to those of attraction; but when life is extinct, the principle of attraction governs, combining the elements in other proportions. This movement of the particles of bodies is called the putrid fermentation, or putrefaction. It is more rapid in animals than vegetable substances. A damp and stagnant air and warm temperature hasten its progress. When vegetables deprived of the living principle are thus situated, they change into a black matter called *mould*, furnishing at the same time a little oil, acetic acid. waters, nitrogen, carburetted hydrogen, and carbonic acid. Animal matter, under the same circumstances, besides most of these products, gives ammonia, and many azotic principles; as a little nitric acid, and perhaps a little hydro-cyanic acid. All the gases which are disengaged, carry with them a little animal matter in decomposition, which gives them an extremely offensive odour.

Fermentation Saccharine. That which produces sugar in bodies where it did not previously exist. It is observed in the germination of many seeds, and in treating starch with sulphuric acid. It appears in both these cases, that there is but one portion of water which combines with starch, (this substance existing in the seeds of plants,) and transforms it to sugar; for 100 parts of starch furnish 110·14 of sugar; and it is found by comparing the analysis, that the 10·14 of increase are only oxygen and hydrogen in proportions necessary to form water.

Ferro-Cyanates. (*Cyano-Ferrures.*) Formerly called *prussiates*. Combinations resulting from the action of hydro-ferro-cyanic (ferro-prussic) acid upon the oxides; with respect to the composition of these, and also that of the simple cyanides, chemists are not agreed in opinion.

Ferro-Cyanate of Barium. (*Cyano-Ferrure de Barium.*) Exists in small yellowish crystals. It is like that of potassium, obtained by treating the hydrate of barytes with prussian blue.

Ferro-Cyanate of Cobalt. (*Cyano-Ferrure de Cobalt.*) *Prussiate of cobalt.* Of a dark green when moist, light green when dry. It is obtained by double decomposition; by pouring a solution of the ferro-cyanate of potash into a solution of the nitrate of cobalt.

FERRO-CYANATE of COPPER. (*Cyano-Ferrure de Cuivre.*) *Prussiate of copper.* Insoluble, of a deep purple colour. When heated strongly it eliminates the hydro-cyanate and carbonate of ammonia and nitrogen; the remainder, which is a carburet of iron and copper, unite at a low temperature, in contact with the air.

FERRO-CYANATE of IRON. (*Cyano-Ferrure de Fer.*) *Prussiate of iron.* See *Blue Prussian.*

FERRO-CYANATE of LEAD. (*Cyano-Ferrure de Plomb.*) *Prussiate of lead.* Insoluble, white, pulverulent. When decomposed by heat, it gives a compound of 1 atom of quadri-carburet of iron, and 2 atoms of quadri-carburet of lead It is obtained by pouring a solution of the ferro-cyanate of potassium into the neutral acetate of lead.

FERRO-CYANATE of LIME. (*Cyano-Ferrure de Chaux.*) *Prussiate of lime.* Of a pale yellow, scarcely crystallizable. It is obtained like the ferro-cyanate of barium.

FERRO-CYANATE of MERCURY. (*Cyano-Ferrure de Mercure.*) *Prussiate of mercury.* An insoluble compound, obtained by pouring a solution of the ferro-cyanate of potassium into a solution of corrosive sublimate. By contact with the air, it decomposes into a cyanide and prussian blue.

FERRO-CYANATE of POTASSIUM. (*Cyano-Ferrure de Potassium.*) *Prussiate of potash.* Of a fine orange colour, transparent, inodorous, of a saltish and slightly bitter taste. Submitted to a heat of 140°, it fuses in its water of interposition, and becomes white; by elevating the temperature to red heat, it undergoes the igneous fusion without any decomposition; at length by raising heat sufficiently intense to affect the glass retort containing the substance, a little nitrogen is eliminated, and the remaining mass is composed of the quadri-carburet of iron, and the cyanide of potassium; but the decomposition is never total. Hydro-chloric acid takes the potash from the ferro-cyanate, and liberates the hydro-ferro-cyanic acid. Cold sulphuric acid dissolves this compound; decomposing it at an elevated temperature; in this change there is a formation of sulphates of iron, potash, and ammonia, and an elimination of sulphurous and carbonic acids and nitrogen. Hot nitric acid also causes a disunion of the constituent principles of this ferro-cyanate, the result being the nitrates of potash and iron. The solution of the ferro-cyanate of potassium is precipitated neither by the alkalies nor alkaline salts. With the salts of the last four sections* it forms precipitates of various colours; the most remarkable are the following: with the protoxide of iron the precipitate is white, and with the deutoxide it is of a very intense bluish green; with the protoxide of copper it is white, and with the deutoxide of a reddish yellow. The ferro-cyanate of potash, formerly called *prussian alkali* and *prussiate of potash*, is in laboratories made with prussian blue. For this purpose, prussian blue of commerce is treated with sulphuric acid diluted with water, in order to carry off the alumine; the residue is washed to divest it of the little acid which it might retain; this residue is then added by small portions into a solution of boiling potash, until the liquor has lost its brownish hue; it is then filtered, evaporated, and crystallized; then redissolved and crystallized anew, to purify it. It is prepared on a large scale for use in the arts, by calcining dried blood or other animal substances, with the sub-carbonate of potash, the same as for prussian blue.

FERRO-CYANIC ACID. See *Acid Hydro-Ferro-Cyanic*. Formerly called ferro-prussic acid.

FERRO-PRUSSIC ACID. See *Acid Chyazic*.

FIBRIN. (*Fibrine.*) A substance very abundant in the animal kingdom; it constitutes the greater part of muscular flesh; it is also found in a minutely subdivided state, in many animal liquids, such as chyle, blood, &c. It is a solid matter, without taste or odour, of a yellowish colour, and like gelatine, semi-transparent, susceptible of absorbing about four fifths of its weight of water, and of then becoming white, flexible, and elastic. Alcohol and ether soften, and in time render it pulpy. The acids act upon it in various ways, sometimes combining with it as the hydro-chloric and weak sulphuric acids; at other times they decompose it, as the concentrated sulphuric acid and nitrous acids. Fibrin dissolves in the alkalies when cold, and is decomposed by potash and soda, with heat. It may be obtained by beating with a bundle of twigs blood recently taken from the veins. Fibrin soon attaches itself to each stem, under the form of long reddish filaments, which become colourless by washing them with cold water; it should then be dried in the open air. According to Gay-Lussac and Thenard, it is composed of

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* See *metals*, Thenard's Sections.

Carbon, - -	50·360
Nitrogen, -	19·934
Oxygen, - -	19·685
Hydrogen -	7·021

Filter. (*Filtre* or *Filtrum.*) An instrument for straining, in order to separate from a liquid any body which may be held in suspension. Paper called cap-paper, is most commonly used; but when the substance to be filtered is of a nature to act upon paper, or would easily obstruct its pores, other substances are used: as wool, tow, sand, charcoal, pounded glass, and even straw, &c.

Filtration. (*Filtratio;* from *filtrum,* a strainer.) An operation, by means of which, a fluid is mechanically separated from consistent particles, merely mixed with it. It does not differ from straining.

Fire. (*Feu,* Latin *Ignis.*) See *Caloric.*

Fixed Air. See *Carbonic Acid Gas.*

Flame. A gaseous matter, whose temperature is sufficiently elevated to appear luminous. See *Caloric.*

Flesh. (*Chair.*) The muscles of animals. They consist chiefly of fibrin, with albumen, gelatine, extractive matter, phosphate of soda, phosphate of ammonia, phosphate and carbonate of lime, and sulphate of potash.

Flour. The powder of the gramineous seeds. Its use as food is well known.

Flowers. A general term used by the ancient chemists to denote all such bodies as have received a pulverulent form by sublimation.

Flowers of Antimony. The sublimated protoxide of antimony.

Flowers of Arsenic. The deutoxide of arsenic.

Flowers of Benzoin. Benzoic acid.

Flowers Martial. Ancient name for the sublimated chloride of iron.

Flowers of Sulphur. Sublimated sulphur.

Flowers of Zinc. Ancient name for the oxide of zinc.

Fluates. By this name are known the combinations of fluoric acids with salifiable bases, combinations which many chemists regard as fluorides ; but as fluoric acid acts, usually like the oxides, especially in its union with boracic acid, silex, and by its action on alcohol which gives rise to an ether similar to that obtained with sulphuric acid, we have thought proper to adopt this hypothesis, until the decomposition of this acid shall decide the question. If these supposed salts, the fluates, are submitted to the action of caloric, they are partly or wholly decomposed if they contain water ; if they contain none, decomposition does not take place.

Water dissolves only those of potash, soda, and silver, except the others are acid fluates. Lime water disturbs all the solutions of the fluates ; strong sulphuric acid sets free their fluoric acid. Many other oxacids and all the hydracids, decompose it equally, but always through the medium of water. Boracic acid combines with fluoric acid and possesses the property of decomposing the dry fluates at a red heat. Silex combines also with fluoric acid, singularly promoting the decomposition of the fluates. In these salts the quantity of oxygen of the oxide is to the quantity of the acid as 1 to 1·373. Those which are soluble are obtained by a direct process, the others by double decompositions. We shall proceed to describe some of the most important fluates.

Fluate of Ammonia. (*Fluate d'Ammonique.*) By pouring weak fluoric acid upon diluted ammonia, and carefully evaporating the liquor, a salt is obtained of a very pungent taste, crystallizing with difficulty, and readily decomposing by heat, which drives off a portion of the ammonia, and afterwards volatilizes it in the state of an acid fluate. It acts in most respects with different bodies in the same manner as the other fluates.

Fluate of Lime. (*Fluate de Chaux.*) *Fluor spar.* Is found abundantly in nature, often in cubic crystals with variable colours. It is phosphorescent with heat, fuses at an elevated temperature. It is employed in the preparations of fluoric acid. It is often called Derbyshire spar, as it is in the mines of Derbyshire, England, that it is chiefly found.

Fluate of Potash. (*Fluate de Potasse.*) Deliquescent, very fusible, not decomposable by heat, even with the aid of water, decomposable by sulphuric acid at the ordinary temperature ; it is obtained by a direct process.

Fluate Acid of Silex. (*Fluate Acide de Silice.*) *Silicated Fluoric Acid.* A colourless gas of a strong odour and caustic taste, extinguishing combustion, having a specific gravity of 3·5735. It is not decomposed by heat, but water acts upon it ; one part containing much silex is precipitated in the state of jelly, the other part very acid dissolves. Boracic acid precipitates the silex, and combines with the fluoric acid ; the alkalies also decompose it. The acid fluate of silex is formed

Silex - -	61·4
Fluoric acid	38·6

It is obtained by treating with sulphuric acid a mixture of the fluate of lime and sand.

Fluate of Silver. (*Fluate d'Argent.*) Is obtained by a direct process. It is very soluble, deliquescent, and possesses many of the properties of the nitrate of silver; it fuses easily, and colours the skin black. Muriatic acid solidifies its solution.

Fluate of Soda. (*Fluate de Soude.*) It is not deliquescent like that of potash, it is less soluble, less fusible, decrepitates before melting. It is obtained by saturating with soda a solution of the acid fluate of silex, filtering and evaporating the liquor, See, for further details respecting the fluates, the works of Gay-Lussac and Thenard, ("*Recherches Physico Chemiques*," tome ii.,) and the Memoirs of Berzelius, ("*Ann de Chymie et de Physique.*")

Fluids Imponderable. By this name are known caloric and light, the electric and magnetic fluids, they being without any known weight; although these fluids give rise to many phenomena in chemical combinations, yet they are all, except *caloric*, considered as properly included under the science of natural philosophy. For information upon *caloric*, see that word.

Fluo-Borates. At present the only combination known of the fluo-boric (boracic) gas is with ammoniacal gas, 1 volume of the former can combine with 1, 2, 3 volumes of the second, giving rise to three salts, only the first of which is solid; the others which are liquid, solidify by heat, losing a portion of the ammoniacal gas which they contain.

Fluoric Acid. See *Acid Fluoric.*

Fluoride of Calcium. Insoluble in water and hydro-fluoric acid, and but slightly dissolved by hydro-chloric (muriatic) acid. It may be formed by digesting newly precipitated carbonate of lime in an excess of hydrofluoric acid.

Fluoride of Manganese. A yellow gas changing to a deep red colour when united with atmospheric air; acting rapidly upon glass, depositing upon it a brown substance, and forming a fluo-silicic acid gas. This gas has been recently discovered by Drohler and Dumas; its farther properties are not known.

Fluorine. (*Fluor.*) The imaginary radical of fluoric acid, called also by the French *phtore.*

Flux. A general term made use of to denote any substance or mixture added to assist the fusion of metals.

Fluxion. See *Fusion.*

Formiates. Compounds of formic acid with the salifiable bases; they are little known, are all soluble in water, crystallizable, and resemble the acetates in many of their properties.

Freezing Mixtures. These depend for their effect upon the disappearance of sensible caloric, when bodies become liquid, especially without the aid of heat: The most usual method for producing artificial cold is to mix equal quantities of snow and salt; the latter having a great affinity for water causes the snow to melt. The salt is then dissolved, and the thermometer marks thirty-two degrees below the freezing point. Other mixtures may be prepared which will reduce the thermometer still lower. The salts employed should be recently crystallized and reduced to powder, and previous to their employment, their temperature should be reduced by cooling. The following are the results of Mr. Walker's experiments upon this subject.

MIXTURES.	Parts.	THERMOMETER SINKS.
Muriate of Ammonia,	5	From 50° to 10°
Nitre,	5	
Water,	16	
Nitrate of Ammonia,	1	From 50° to 4°
Water,	1	
Sulphate of Soda,	5	From 50° to 3°
Sulphuric and Diluted,	4	
Muriate of Lime,	3	From 32° to —50°
Snow,	2	
Snow,	2	From —10° to —56°
Diluted Sulphuric Acid,	1	
Diluted Nitric Acid,	1	
Snow or Ice, pounded,	12	From —18° to —25°
Common Salt,	5	
Nitrate of Ammonia,	5	
Muriate of Lime,	3	From —40° to —73°
Snow,	1	
Diluted Sulphuric Acid,	10	From —68° to —94°
Snow,	8	
Phosphate of Soda,	9	From 50° to —21°
Nitrate of Ammonia,	6	
Diluted Nitrous Acid,	4	

Fuliginous. (From *fuligo*, soot.) Vapours which possess the property of smoke, or soot.

Fulmination. *Detonation.* A quick and lively explosion of bodies.

Fulminating Substances. (*Fulminates.*) Such as are remarkable for a property of detonating by slight friction or exposure to a high temperature. Fulminating silver, which is better known than any of the substances of this class, is soluble in 36 parts of boiling water. Potash and soda poured into this solution precipitate part of the soda and form a double salt. Most of the metals which are introduced into this solution take the place of the silver, and form other fulminates, whose properties are not well known. The fulminate of silver, usually called fulminating powder of silver, is obtained by precipitating with alcohol a solution of silver in nitric acid; most of the others may be obtained by an analogous process. According to Gay-Lussac and Liebig, the fulminate of silver is composed of 77·528 oxide of silver, 22·472 fulminic acid.

Fumigation. (From *fumus*, smoke.) The application of fumes to destroy effluvia or contagious *miasmata*.

Fungin. (*Fungine.*) A name given by Braconnot to the fibre of mushrooms, which differs from woody fibre in containing nitrogen. It is obtained by successively boiling mushrooms in an alkaline water. It is white, soft, tasteless, insoluble in most substances, dissolves by heat in muriatic acid, is decomposed by nitric acid, giving among other products oxalic acid and two peculiar oily substances.

Furnaces. Instruments used in exposing bodies to the action of caloric; their forms are various, according to the uses for which they are designed. The following are some of the most common:

1st. The *evaporating furnace;* it is employed to reduce substances into vapour by means of heat in order to separate the more fixed principles from the more volatile.

2d. The *reverberatory furnace*, which name it has received from its construction; the flame being prevented from rising, it is appropriated to distillation.

3d. The *forge furnace*, in which the current of air is determined by bellows.

Fusion. (From *fundo*, to pour out.) A process by which bodies are made to pass from a solid to a fluid state by the application of heat. Salts are liable to two kinds of fusion, the one owing to water contained in the salt, this is called the *aqueous fusion;* the other, which arises from heat alone, is called the *igneous fusion*,

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Galbanum. The juice of the *Bubon galbanum.*

Galena. (*Galene.*) Mineralogical name for the sulphuret of lead.

Galls. Protuberances produced by the puncture of an insect on plants and trees of different kinds; some of them are hard and called nutgalls, others are soft and spongy, and called berry-galls, or apple-galls. (See *Gallic Acid.*)

Gallates. Salts resulting from the combination of gallic acid with bases; they are little known; those of potash, soda, and those of organic bases, are soluble and without colour. The gallate (per) of iron is blue; all the gallates are decomposable by fire. All the strong acids seize upon their bases; the gallate of iron is decomposed by oxalic acid. The neutral gallates of cinchonine and quinine are insoluble, except in an excess of acid.

Galley. (*Galère.*) A long reverberatory furnace, around the interior of which are arranged rows of vessels, as retorts, crucibles, &c. to be heated at the same time. Some galleys consist of a long furnace covered with an arch, with a chimney at one end, and at the other a door for the introduction of the fuel. On account of the appearances of the furnaces, and the lateral openings, they are supposed to have some resemblance to a row-galley; this has given rise to their name.

Galvanism. A professor of anatomy in the university of Bologna, named Galvani, was one day making electrical experiments in his laboratory; near the machine were some frogs that had recently been flayed, the limbs of which became convulsed every time a spark was drawn from the apparatus. Galvani, surprised at this phenomenon, made it a subject of investigation, and iscovered that metals applied in a certain manner to the erves and muscles of these animals, occasioned powerul and sudden contractions. He gave the name of aninal electricity to this order of new phenomena, from the analogy that he considered as existing between these effects and those produced by electricity. The name of animal electricity has been superseded by that of galvanism, in honour of the discoverer.

Gangue. The stones and earths which surround mines, and in which the ores are imbedded.

Gas. (From *Geist*, German, signifying *spirit.*) *Gaz.* The gases are aeriform, very elastic and compressible, of a specific gravity varying according to their nature and the presence of the atmosphere; some are absorbed with great facility by charcoal and other porous bodies, others are absorbed with difficulty. The number of gases is estimated at 26; it is probable that future discoveries will increase this number. The gases vary in their appearances and qualities; for example, some may be liquefied by a high pressure or low temperature; some are coloured, others diffuse white fumes; some extinguish combustion, others restore combustion after it has been extinguished; some are acid, others are alkaline; some are deleterious, producing a strong odour; many dissolve in water.

1. The *coloured gases* are nitrous acid, chlorine, the protoxide and deutoxide of chlorine. The first is red, the rest yellowish green, or yellowish.

2. Gases producing *white vapours* in the air, muriatic, fluoboric, fluosilicic, and hydriodic acids.

3. Gases *inflammable* in air by contact of the lighted taper. Hydrogen, sub-carburetted, carburetted, subphosphuretted, phosphuretted, sulphuretted, arsenuretted, telluretted, and potassuretted hydrogen, carbonous oxide gass and prussine or cyanogen.

4. Gases which *rekindle* the expiring taper: oxygen, protoxide of azote, nitrous acid, and the oxides of chlorine.

5. *Acid* gases which *redden* litmus. Nitrous, sulphurous, muriatic, fluoboric, hydriodic, fluosilicic, chlorocarbonous, and carbonic acids, the oxides of chlorine, sulphuretted hydrogen, telluretted hydrogen, and cyanogen.

6. Gases *destitute of smell*, or possessing but a feeble one: oxygen, azote, hydrogen, sub-carburetted and carburetted hydrogen, carbonic acid, protoxide of azote.

7. The smell of all the others is insupportable, and frequently characteristic.

8. Gases very *soluble in water;* namely of which water dissolves more than 30 times its volume at ordinary pressure and temperature. Fluoric, muriatic, fluosilicic, nitrous, and sulphurous acids, and ammonia.

9. Gases *soluble in alkaline solutions.* Acids nitrous, sulphurous, muriatic, fluoboric, hydriodic, fluosilicic, chlorine, carbonic, chloro-carbonous, and the two oxides of chlorine, sulphuretted hydrogen, telluretted hydrogen, and ammonia.

10. *Alkaline* gases. Ammonia and potassuretted hydrogen.

As it is not possible to give a general description of the various gases which would in any degree illustrate their peculiar qualities, each gas will be described under its appropriate head.

GAS HYDROGEN See *Hydrogen.*

GAS OLEFIANT. See *Bicarburetted Hydrogen.*

GAS INFLAMMABLE. See *Hydrogen.*

GAS NITROUS. See *Oxide of Nitrogen* (*Deuto.*)

GAS DEPHLOGISTICATED. See *Oxygen.*

GAS of MARSHES. (*Gaz des Marais.*) See *Carburetted Hydrogen.*

Gastric Juice. A peculiar fluid secreted by the stomach to assist in the digestive process. Its taste is saline, and vegetable colours are not affected by it.

Gelatine. Gelly, or jelly. An animal substance soluble in water, but not in alcohol, capable of assuming a well known elastic or tremulous consistence by cooling, when the water is not too abundant, and liquefiable again by increasing the temperature. This last property particularly distinguishes it from albumen, which acquires consistence by heat. Gelatine, or jelly, is the principal ingredient of skin and all the membranous parts of animals. It may be obtained by boiling in water, under the forms of glue, size, isinglass, and transparent gelly.

Gentianine. A name proposed by Henry and Caventon, in order to designate a crystallizable substance of a bitter taste, analogous to gentian, having no action upon either litmus or curcuma paper. It is very soluble in alcohol and ether. It is obtained by treating powdered gentian with ether; the solution is evaporated, and the residue treated with alcohol; this solution is then evaporated, the new residuum is diluted in water, and a little magnesia added to saturate the acid; this is evaporated, and then dissolved by ether, which unites with the gentianine, and deposites the salt of magnesia; by the last evaporation are obtained small yellow crystals which appear to be in a state of purity.

Germination. The vital developement of a seed when it begins to grow.

Glass. (*Verre.*) May be regarded as a compound of silex, soda, potash, and sometimes the oxides of lead, manganese, &c.

Glass Common. Consists of sand 100 parts, impure soda 100, fragments of old glass 100. Glass may be made of different colours by the addition of coloured metallic oxides: thus the peroxide of manganese gives a fine violet colour; cobalt, an azure blue; the oxide of chrome, a greenish blue, &c.; the oxide of manganese, a beautiful red, &c. The artificial stones for jewellery are only glass coloured by metallic oxides.

Glass of Antimony. (*Verre d'Antimoine.*) Transparent, of a hyacinth colour, very brittle; it is a compound of the oxide of iron, silex, alumine, a large portion of the protoxide of antimony, and a little of the sulphuret of antimony. It is prepared by melting at an intense heat the liver of antimony in large crucibles of silicious clay; one portion of the sulphur burns, and the metal is oxidized. It is evident that the silex, alumine, and one part of the oxide of iron, are derived from the crucibles, which were attacked during the fusion of the metal. This glass is opaque if it contain an excess of sulphur. Vauquelin has shown that without iron, it would be of a beautiful yellow; its transparency is owing to the silex. The glass of antimony is employed in the arts in various ways; it is sometimes used for the preparation of tartar emetic.

Glauber's Salts. See *Sulphate of Soda.*

Gliadine. (*Glia*, glue.) This substance has been recently discovered in gluten. It is of a yellow colour and sweetish taste, is soluble in acids, alkalies, and alcohol, but is not dissolved by water.

Glucina. (*Glucine.*) See *Oxide of Glucinum.*

Glucinum. This metal is only known in the state of an oxide. See *Oxide of Glucinum.*

Glue. See *Gelatin.*

Gluten. Is soft, elastic, of a grayish white, viscous, and almost tasteless. In a dry state it becomes brown and of a glassy brittleness; submitted to a high heat, it decomposes like animal matter, leaving a brilliant and voluminous charcoal; exposed to dry air, it is covered with an oily surface, and becomes very hard; but if the air is moist, it swells, putrifies, and diffuses a fetid odour analogous to cheese. It does not dissolve in cold water; warm water destroys its tenacity and elasticity, without dissolving it; it is insoluble in alcohol. The vegetable acids, especially concentrated acetic, muriatic, and some other mineral acids, by the aid of a mild heat dissolve gluten. Charcoal and sulphuric and nitric acids act upon it as upon most animal substances. M. Taddei, an Italian chemist, does not consider gluten as an immediate principle, but as formed of two principles, *gliadine*, from the Greek *glia*, gluten, and *zimome*, from *zume*, yest. To obtain gluten, a paste of wheaten flower is washed in a large quantity of water, which carries off the fecula, and dissolves the albumen and the sugar which were lodged between the interstices of the gluten; it is pure when it no longer disturbs the transparency of the water. The knowledge of gluten is due to Beccaria, an Italian chemist.

Glycerine. A name proposed by Chevreul to designate a substance which Scheele has regarded as an immediate principle, and called the sweet of oils. Fremy and Chevreul have demonstrated that it is formed by the action of metallic oxides upon fat substances. It is said to consist of 100 of oxygen, 70·70 of carbon, and 16·99 of hydrogen. It is colourless, of a sweet taste, without any acid; its density is 1·252. It attracts moisture from the air, furnishes oxalic acid when treated with nitric acid, does not ferment, and of course does not yield alcohol.

Gold. (Latin *aurum*, French *or*.) A metal, solid, pure, yellow, very brilliant, without taste or odour. It is one of the most ductile and the most malleable of [illegible] leaf so thin as to cover a fine silver wire of nearly fourteen hundred miles in length. Its tenacity is very great; its specific gravity is 19·257; it is less fusible than silver, being fused but at a heat of 32° Wedgewood's pyrometer. It has been melted in a reverberatory furnace; submitted to a greater heat, it does not volatilize. It has no action, at any temperature, upon atmospheric air and oxygen gas.

Most chemists even affirm that it is not oxidized by the strongest electrical discharge; they regard the red powder which is formed in this case as gold minutely subdivided. It unites to most of the metals, and to bromine, chlorine, sulphur, iodine, and phosphorus. Gold has been known from the most remote antiquity; the alchemists regarded it as the most perfect of metals; they called it the *sun* or *the king of metals*. It exists always pure or alloyed with iron, silver, or copper; it is sometimes found crystallized in cubes or octoedrons united in little groups, but most commonly in thin scales, spangles, or grains, either in gangues or isolated. It occurs in veins of lead, silver, and with sulphuret of iron. The most extensive mines of this metal are those ot Mexico, Peru, Transylvania, and Hungary. It is found in little scales or spangles in the sands of Brazil, mingled with platina and the diamond, and also in the southern United States. In Africa it is washed down from the mountains by the rivers, and obtained from their sands.

According to the calculation of Humboldt, the old continent furnishes every year 4000 kilogrammes of gold, while America, much more rich, furnishes 18,000 kils., equal to 54,300,000 francs, equal in all to 189,500,000 frs. The operation of working gold mines is carried on as follows: The workmen wash upon inclined tables covered with cloth the auriferous or gold-bearing sands; they obtain for a residuum sands more and more rich; these they [illegible] amalgam, which they wash with many waters in order to carry off the earthy matter. This amalgam is put into sacks of coarse cloth, and exposed to heavy pressure. The excess of the mercury passes through the interstices of the sacks, and a solid amalgam remains, from which the gold is obtained by heating, as the mercury being very volatile is wholly disengaged. The use of this precious metal as coin, for ornament, utensils, jewels, &c., is known in all civilized countries, and even among savages. Gold coin usually contains 11 parts of gold and 1 of copper. The *purple of Cassius* is obtained from the chloride of gold precipitated by the proto-chloride of tin.

Grand Oeuvre. A term synonymous with *philosopher's stone*, used by the alchemists to designate their pretended process for making gold.

Green of Scheele. (*Vert de Scheele.*) A combination of the deutoxide of copper and the oxide of arsenic. It is of a beautiful apple-green colour, pulverulent, insoluble in water; exposed to the action of fire, it diffuses a strong odour of arsenic, and leaves a brown residue composed of the deutoxide of copper. Sulphuretted hydrogen immediately changes Scheele's green into sulphurets of copper and arsenic. Some chemists admitting an arsenious acid, regard Scheele's green as an *arsenite of copper*. In order to obtain this green, boil for half an hour 11 ounces of white oxide of arsenic with 2 pounds of carbonate of potash; leave it to deposite, and pour into the liquor a solution of 2 pounds of sulphate of copper in 17 pints of water; agitate the mixture, and Scheele's green will be precipitated; let it drain upon a strainer, and wash it many times, to separate the sulphate of potash; this quantity produces 2 pounds of the green. Braconnot has recently published a process by which a green as beautiful as Scheele's may be obtained. It consists in dissolving 8 parts of the white oxide of arsenic in 8 parts of the potash of commerce, decomposing the solution by 6 parts of the sulphate of copper, and mixing the precipitate with 3 parts of acetic acid. Scheele's green is used in the painting of paper hangings and in oil painting.

Gum. (*Gomme.*) An immediate product of vegetables, uncrystallizable, colourless, insipid, inodorous, insoluble in alcohol, soluble in water, forming with it a gelatinous compound known under the name of mucilage. Gum cannot be made to pass through the alcoholic fermentation; treated with nitric acid, it is changed into muc acid; submitted to the action of fire, it swells, and gives product analogous to vegetable substances; the alkalie and weak acids dissolve it; alcohol and the subacetate o lead precipitate it from all its solutions. Gum is universally diffused throughout the vegetable kingdom, being found in all the parts of herbaceous plants, in many roots, and in all fruits. Many trees, particularly the drupaceous, as the cherry, plumb, &c., naturally secrete gums, those which are used in commerce being of this kind. Gum varies much in its physical properties, according to the species of tree which furnishes it.

The principal gums are: 1st, the *Common Gum* obtained from the peach, plum, cherry tree, &c. 2d, *Gum Arabic*, which flows naturally from the Acacia tree in Egypt, Arabia, and elsewhere; this forms a clear transparent mucilage with water. 3d, *Gum Seneca*, or *Senegal;* differing but little from gum Arabic. 4th, *Gum Adraganth* or *Tragacanth*, obtained from a small plant of the same name, in Syria. These gums are much used both in the arts, and in medicine.

Gum Artificial. Starch properly torrified or heated entirely loses its properties, and is transformed into a gummy matter, soluble in water. This solution is not affected by iodine. It is distinguished from the proper gums, in its solution not being disturbed by the acetate of lead, and in not giving the mucic acid when treated with nitric acid. (*Saussure.*) This substance is employed as a substitute for the tapioca or cassada root, sago and other exotic pastes.

Gum Resins. Substances of a colour very variable, usually of a strong odour and a pungent taste, heavier than water, in which they are soluble; they are soluble in alcohol. Water disturbs the alcoholic solution, precipitating the resinous part, and according to Hatchett, potash and caustic soda dissolve the gum resins. They are formed of a concretion of several immediate principles. They are contained in the vessels of plants, and flow from them with a milky appearance. The Euphorbia genus and many of the umbelliferous plants furnish these gums in abundance; among the gum resins are Assafœtida, Scammony, Aloes, Gum Ammoniac and Gamboge.

Gunpowder. (*Poudre a canon.*) It is a mixture of the nitrate of potash, sulphur, and charcoal. The violent explosions produced by this composition are well known. The manufacture of this powder is carried on in large buildings prepared for the purpose, called by the French *poudrières*. In selecting the substances great caution must be used; the sulphur should be as pure as possible, the nitre should be cleared of all its deliquescent matter, the charcoal should be recent, very dry and light. The substances are then all pulverized and mixed in the following proportions: first, for powder to be used in war,

Saltpetre	75
Charcoal	12·50
Sulphur	12·50

In powder for mining, &c., the proportions are somewhat varied.

It is very necessary that the materials should be minutely subdivided and intimately mixed. It should be preserved in very dry magazines. Berthollet found that the elastic product afforded by the detonation of gunpowder consisted of two parts of nitrogen, and one of carbonic acid gas. The extrication and explosion of these vapours are the cause of the effect of gunpowder. This composition was discovered by friar Roger Bacon; but it is by many believed that the Chinese were previously acquainted with it. Those who would farther inquire respecting the manufacture of this substance are referred to the work of MM. Bollée and Tiffiout.

Gypsum. (*Gypse.*) See *Sulphate of Lime*.

H.

Hartshorn (Spirit of.) See *Ammonia.*

Heat. See *Caloric.*

Hematin. A crystallizable substance, white, bitter, and sharp to the taste; it was discovered by Chevreul in the Campeachy wood (*Hematoxylon campechianum.*) To procure it, the powdered Campeachy wood should be digested with water at the temperature of 122°, the liquor is then evaporated to dryness, and the residuum put into alcohol; in two days it should be filtered, and concentrated by evaporating; a small quantity of water is then added and it is left to crystallize; the crystals are purified by washing in alcohol.

Hircine. (From *hircus*, a goat.) A liquid substance which exists in the fat of the goat and sheep. It is much more soluble in alcohol than elaine, and is obtained by an analogous process.

Honey. (*Miel.*) Is a substance varying in colour from white to yellow, and sometimes to brown. Its taste is sweet and aromatic. It is prepared by bees, by introducing into their stomachs the viscous juice and sugar which they collect in the nectaries of flowers, after remaining in this laboratory for a time, it is deposited in the cavities of the honey comb. It is not known whether honey is a product of nature or of these insects, since in the nectaries of many plants is to be found a honey-like juice; in the morning, before the rising of the sun, many vegetables, such as the oak, pear tree, &c., are covered with an abundant honey-like liquid which bees seek with eagerness. Honey varies in its quality partly on account of the state of the atmosphere, but chiefly from the different plants from which it is extracted. All the labiate plants furnish excellent honey; while some of the *solanæ* (of which natural family are the tobacco, potato, &c.) furnish that which is poisonous. Of the various kinds of honey, that of mount Hymettus, of mount Ida, of Cuba, and Mahon, is highly esteemed, having the appearance and consistence of the most beautiful sirup of sugar. Honey is composed of two kinds of sugar, the one liquid, the other crystallizable analogous to the sugar of grapes; these united with an aromatic substance, constitute honey in all its varieties.

Hordein. (From *hordeum*, barley.) An inodorous substance, insipid, yellowish, pulverulent; it was discovered by Proust in great quantity in the flour of barley. It dissolves neither in hot nor cold water, nor alcohol. It is extracted in great quantities by washing a paste of barley flour in a large quantity of water, as described under the article gluten. The hordein and starch are deposited, they are separated by boiling in water, the starch dissolves and the residuum is hordein; some washings are then necessary in order to render it pure. Nitric acid changes it into oxalic and acetic acids.

Horn. A substance formed according to the analysis of Vauquelin of dried mucus, a small quantity of oil, and gelatine.

Hydracids. By these substances chemists understand those which result from the combination of hydrogen with a simple combustible body and which possess all the characters belonging to acids generally; but five hydracids are well known: viz. *Hydro-chloric*, *Hydro-sulphuric* (sulphuretted hydrogen) *Hydriodic*, *Hydro-cyanic* and *Hydro-selenic* acids. (See each of [illegible] cording to many chemists, the hydracids decompose whenever they are united to metallic oxides; that is, the hydrogen of the acid combines to form water with the oxygen of the oxide, and the two simple bodies being set free form a compound which is a chloride, an iodide, &c., according to the hydracid employed; others regard the compounds which they form as true salts; some agree with both these theories, by admitting that they are salts while they remain dissolved, but cease to be so when dried.

Hydrargyrated. Of or belonging to mercury.

Hydrates. *Hydroxide.* *Hydroxure.* Proust first proposed the name of hydrate, in order to designate the compound which is formed when metallic oxides absorb and solidify a certain quantity of water; most of the hydrates lose the water which they absorb, those of potash and soda never part with it, to whatever degree of heat they may be submitted. Berzelius thinks that in the hydrates, the quantity of oxygen contained in the oxides is equal to the quantity of oxygen contained in the water; Thomson believes there may be many hydrates of the same oxide. These compounds have in general a colour different from the oxides; for example, the hydrate of lime is white, while the oxide is grayish; that of copper is blue, while the dry deutoxide is brown, &c. Many hydrates are found formed in nature, as the hydrate of silex or opal, the hydrate of alumine or diaspore, and many others. Hydrates are obtained in laboratories, by dissolving in water a salt whose oxide is insoluble in this fluid, pouring into the solution an excess of soda, potash, or ammonia, then washing the flosculous or gelatinous substance.

Hydriodates. Salts resulting from the combination of hydriodic acid with organic salifiable bases or ammonia. (For the metallic hydriodates, see *Iodides.*) Under the article *Hyd*ve to these last substances.

Hydriodate of Ammonia. Crystallizes in cubes, is volatile. Heated in close vessels it sublimes in the same manner as sal ammoniac; but if the salt is heated in the air, it undergoes a little alteration, taking a tinge more or less deep, which is owing to the iodine. It is composed of one volume of ammoniacal gas, and one volume of hydriodic gas. It is obtained by combining directly, liquid hydriodic acid with ammonia.

Hydriodide of Carbon. (*Hydriodure de Carbon.*) A crystalline compound, white and friaible, which is obtained by exposing to the influence of solar rays deuto-carburetted hydrogen gas with iodine, a combination soon takes place; by the aid of a solution of potash, the excess of iodine is disengaged. The hydriodide of carbon is soluble in ether and alcohol. Thenard, on account of the great analogy which exists between iodine and chlorine, thinks that this is rather a *hydro-carburet of iodine*.

Hydro-Bromate. This term is used to designate the compounds formed by the union of hydro-bromic acid with different bases. These salts have not as yet been fully examined; we have however, *hydro-bromate of ammonia*, a volatile white salt; that of *barytes* appears in opaque crystals. They are both soluble in water. The *hydro-bromate of magnesia* does not crystallize, and is decomposed when exposed to a high temperature.

Hydro-Carburet of Bromine is the combination of bromine with olefiant gas, colourless, with a penetrating odour and sweet taste; it is very volatile. At a temperature of 22°, it becomes solid.

Hydro-Carburet of Chlorine. (*Hydro-Carbure de Chlore.*) Liquid, oily, colourless, of a sugared taste, an odour resembling that of ether; it has no action upon vegetable colours. This liquid, exposed in a retort to the action of fire, soon boils and becomes coloured; it is set on fire by the approach of an ignited body; one portion of the carbon is burnt, the other disengaged; the hydrogen and chlorine combine to form hydro-chloric acid, which appears in white and pungent fumes. MM. Robiquet and Colin, who investigated this substance, found that it has a great analogy with hydro-chloric ether; they regard it as composed of nearly equal parts in volumes of bicarburetted hydrogen and chlorine. In order to procure the hydro-carburet of chlorine, a current of bicarburretted hydrogen gas is introduced into a large balloon or globe, and another current of chlorine in equal volumes; the two gases unite without affording any other product. This product is purified by washing in a small quantity of water. Its discovery is due to the German chemists, who called the bicarburetted hydrogen, *olefiant gas*.

Hydro-Carburet of Iodine. A white sweetish substance, soluble in ether and alcohol, and crystallizing in prisms. It is decomposed by heat, and gives out iodine. Faraday first obtained it by exposing olefiant gas and iodine in the same receiver to the direct rays of the sun.

Hydro-Chlorates. *Muriates.* Combinations of hydrochloric (muriatic) acid with ammonia, and salifiable organic bases. For the metallic hydro-chlorates, see *Chlorides*.

Hydro-Chlorate of Ammonia. *Muriate of ammonia. Sal ammoniac.* A white solid salt, of an acid taste; somewhat elastic, ductile, unalterable by the air; cold water dissolves about one third of its weight; boiling water dissolves a much greater proportion. The solution carefully evaporated, crystallizes in groups of prismatic plume-like needles. Exposed to the action of caloric, if the heat is carefully applied, it sublimes in rhomboidal forms; but if the operation is hastened, it condenses into a mass more or less compact. The hydro-chlorate of ammonia calcined with lime disengages ammonia and a chloride of calcium, which remains fixed. This salt is obtained from animal products; it is found in some volcanoes and lakes. There are various methods of manufacturing it; among others is the following, discovered by Baume: it consists in introducing the clippings of wool, bits of leather, or old shoes, into iron cylinders, horizontally placed in a reverberatory furnace. At one end of the cylinder is an aperture which may be opened to introduce substances; at the other is a large tube placed in a vessel of water, and the apparatus is completed by a strait tube for the disengagement of the gas. The products are usually the acetate and the hydrocyanate of ammonia, oil, and a great quantity of the subcarbonate of ammonia. When the operation is completed, a certain quantity of diluted sulphate of lime is added. Decomposition soon takes place, giving rise to the formation of sulphate of ammonia and carbonate of lime, the one soluble, the other insoluble. An excess of common salt is poured into the solution of the sulphate of ammonia; there is now a formation of hydro-chlorate of ammonia and sulphate of soda. This mixture is evaporated to dryness, and then in a proper apparatus submitted to a slow heat; after three days the sal ammoniac will have separated by sublimation. This is whiter and more pure than that imported from Egypt. Braziers, who use it for separating verdigris from copper, prefer that which is gray; it is also employed in painting and medicine.

Hydro-Chlorate of Cinchonine. Crystallizes in little elongated prisms; it is much more soluble than the sulphate of the same base, and is composed of cinchonine 100, hydro-chloric acid 8·90.

Hydro-Chlorate of Morphine. Very bitter, crystallizable. It is obtained like the preceding, by combining directly the base with diluted acid, and evaporating the salt by a slow heat.

Hydro-Cyanates. Salts resulting from the combination of hydro-cyanic acid with ammonia or vegetable bases. For metallic hydro-cyanates, see *Cyanides*.

Hydro-Cyanate of Ammonia. Its crystals are in cubes, or resemble fern leaves; it is excessively volatile, and easy to be decomposed by the action of fire. [illegible] obtained by a direct process. This salt has been studied only by Gay-Lussac.

Hydro-Ferro-Cyanates. Combination of the hydro-ferro-cyanic acid with bases. For the metallic hydro-ferro-cyanates, see *Ferro-Cyanates.*

Hydro-Ferro-Cyanate of Ammonia. This salt is prepared like the ferro-cyanate of lime. Exposed to the action of heat in a retort, the hydro-cyanate of ammonia sublimes, and the residue, which is composed of the cyanide of iron, decomposes into nitrogen gas, and a carburet of iron, which, when heated to redness, unite. (See *Ann. de Chimie, et de Physique*, tome XV. p. 225.)

Hydro-Fluates. These are salts formed by the combination of hydro-fluoric acid with the pure alkalies. With muriate of lime a thick precipitate is formed, which yields, when heated with strong sulphuric acid, the hydro-fluoric acid.

Hydro-Fluate of Ammonia. This neutral salt is soluble in water, slightly so in alcohol; it acts rapidly upon glass even when dry. It is prepared by mixing in a platinum crucible, one part of muriate of ammonia, and 2¼ parts of fluoride of sodium, in a state of dry powder; on applying a gentle heat, the hydro-fluate of ammonia sublimes, and condenses in small prisms on the lid of the crucible, which, during the operation, must be kept cool.

Hydro-Fluate of Lithia. The *acid* and *neutral* hydro-fluates of this substance, are sparingly soluble in water.

Hydro-Fluate of Potassa. (*Bi-Hydro-Fluate.*) Forms rectangular crystals. It is soluble in water, decomposes by heat, and reddens vegetable colours. It consists of two equivalents of acid, and one of potassa. The *hydro-fluate* contains only one portion of acid, united to one of potassa; it is prepared by super-saturating carbonate of potash with hydro-fluoric acid, evaporating the solution to dryness, and heating it until the excess of acid is expelled. This salt has the properties of alkalies.

Hydro-Fluate of Soda. The *acid* hydro-fluate crystallizes in transparent rhombs, has a sharp sour taste, and is sparingly soluble in cold water. The *neutral*, commonly crystallizes in cubes, is almost insoluble in alcohol, is sparingly soluble in water even at an elevated temperature. These salts are prepared like the preceding.

Hydrogen. (*Hydrogène.*) A word derived from the Greek, signifying to produce water, which it does by an union with oxygen. A gas, colourless, insipid, inodorous. Its specific gravity compared to that of air, is but 0·0688. Upon this property is founded the theory of ærostatic balloons; it also enables the chemist easily to transfer the gas from one bell-glass to another, as by its levity it takes the upper part, pressing down the atmospheric air with which the bell-glass might be filled, in the same manner as gases usually rise through water, and fill the receivers. Hydrogen gas, though itself very inflammable, extinguishes combustion.

This gas experiences no alteration by the most intense heat, except in expansion. At the ordinary temperature it does not combine with oxygen; these gases may for a long time remain mixed without uniting; but if the temperature is raised to a red heat, combination takes place in the proportion of 1 part of hydrogen, and one of oxygen, forming water. Combination is also instantaneous, if into a eudiometer containing a mixture of these two gases, an electric spark is introduced. If, after having over water filled a flask with two parts of hydrogen and one of oxygen, and surrounded it with a cloth, a lighted taper is presented to the opening of the flask, a violent detonation will take place; this is owing to the liquefaction of the two gases, and also to the expansion of the water, which, brought into a state of vapour by the heat, occupies much more space than was required for the simple mixture of the gases. Instead of mixing the gases in a flask, they may be introduced into a vessel containing soap-suds; this is done by first filling with the gases a bladder furnished with a stop-cock; the soap-suds is made to froth, and the surface becomes covered with bubbles, by the introduction of the gases; these bubbles will be set on fire, and produce a series of detonations, by applying a lighted taper, which may be attached to the end of a stick.

Biot has shown that a combination of oxygen and hydrogen gases may be effected by powerful compression. Notwithstanding the inflammable nature of hydrogen, it cannot take fire through a close metallic net-work. Sir H. Davy, in discovering this fact, was led to the invention of his *safety lamp*, which is of the highest importance to miners, whose lives, previous to this invention, were often sacrificed by sudden explosions of this gas, caused by its contact with the flame of their torches. Dobereiner has recently discovered, that in directing through atmospheric air a current of hydrogen upon spongy platina, palladium, or rhodium, the metal reddens and forms water. Hydrogen unites with sulphur, chlorine, carbon, phosphorus, selenium, iodine, nitrogen, potassium, tellurium, and arsenic. This gas is, of all combustible bodies, that which in burning produces the most heat; when the flame of hydrogen mixed with oxygen is directed upon metallic substances, there are few that are not immediately fused.

Hydrogen is one of the most generally diffused substances in nature; it enters into the composition of all animal and vegetable substances, of water, all the hydracids, of ammonia, &c. It is obtained as follows: Into a flask with two tubulures are put pieces of zinc, with a little water; to one of the tubulures is fitted a tube which communicates with the pneumatic cistern; through the other tubulure is poured sulphuric acid; a lively effervescence occasioned by the decomposition of the water takes place; the tubulure is left unstopped for a short time, in order that the first portions of gas, which are mixed with atmospheric air, may pass out; receivers filled with water are placed on the shelf of the cistern; the gas by its levity displaces the water, and fills the receivers. Hydrogen gas may also be prepared with iron filings. The æronauts follow the same process in inflating their balloons. This gas was discovered in the beginning of the 17th century, and was studied in 1777 by Cavendish, who called it *inflammable air.*

Hydrogen Arseniuretted. (*Hydrogène Arseniqué.*) A colourless gas, of an insupportable odour; its specific gravity according to Davy is 0·5552. It has no action upon vegetable colours; its action upon the animal economy shows it to be among the most deleterious of all substances. Professor Gehlen, having breathed a certain quantity of this gas, was seized with vomiting, chills, great debility, and after nine days died in appalling agonies. Arseniuretted hydrogen seems not to be decomposed at the ordinary temperature. M. Stromeyer liquefied it, by exposing it to a cold below zero; heated with a sufficient quantity of oxygen gas, it is transformed into water and deutoxide of arsenic. When a mixture of arseniuretted hydrogen and oxygen are inflamed in a flask, there is a powerful detonation, a formation of water, and a deposite either of the oxide of arsenic or the hydruret of arsenic. Chlorine rapidly decomposes it, the hydrogen uniting with it to form hydro-chloric acid. This gas, according to Stromeyer, is composed of 10·89 of arsenic, and 1·24 of hydrogen.

It is obtained by exposing to gentle heat a mixture of equal parts of tin and arsenic with four or five parts of hydro-chloric acid; gas disengages by the decomposition of the acid, and the chloride of tin remains. In order to avoid respiring it, it is collected in flasks over the hydragiro-pneumatic cistern. This gas has been the object of the successive researches of Scheele, Proust, Tromsdorff, and Stromeyer.

Hydrogen Borruretted. Although the affinity of boron for hydrogen is slight, yet by mixing 1 part of boracic acid with 4 parts of iron-filings, exposing them in a crucible for half an hour, dissolving the resulting mass in hydro-chloric (muriatic) acid, this gas is produced. It burns with a yellow flame and white fumes, giving out an odour like arsenic. It was discovered by Gmelin.

Hydrogen Carburetted (Deuto.) See *Carburetted Hydrogen (Deuto.)*

Hydrogen Carburetted (Per or Quadri.) See *Carburetted Hydrogen (Per.)*

Hydrogen Phosphuretted (Per.) See *Phosphuretted Hydrogen.*

Hydrogen Potassuretted. See *Potassuretted Hydrogen.*

Hydrogen Selenuretted. See *Selenuretted Hydrogen.*

Hydrogen Sulphuretted. See *Sulphuretted Hydrogen.*

Hydrogen Telluretted. See *Telluretted Hydrogen.*

Hydro-Seleniates. Berzelius has ascertained that hydro-selenic acid unites with the alkalies, forming soluble compounds which resemble the hydro-sulphates, and precipitate the salts of the common metals. They are however but little known.

Hydro-Sulphates. (*Hydro-Sulfates.*) *Hydro-sulphurets.* Combinations of sulphuretted hydrogen with ammonia and vegetable alkalies. For metallic hydro-sulphates, see *Sulphurets.*

Hydro-Sulphate of Ammonia. (*Hydro-sulfate d'Ammoniaque.*) *Hydro-sulphuret of ammonia.* A white salt, translucid, crystallizing in transparent scales. It is insoluble, but so volatile that at the ordinary temperature it sublimes to the upper part of the flask in which it is contained. It is decomposed in the air by absorbing oxygen, and passes to the state of a sulphuretted hydro-sulphate. This salt is formed in nature by a decomposition of animal substances; it is obtained in laboratories by combining directly ammoniacal gas with sulphuretted hydrogen at a very low temperature. For this purpose, the two dry gases are introduced by tubes into a flask surrounded with ice; this flask has a third tube which is placed under mercury, in order to give vent to the excess of the gases, and at the same time avoid contact with the air. As the hydro-sulphate of ammonia is often used as a re-agent, it is sometimes prepared in a liquid state by saturating liquid ammonia with a current of sulphuretted hydrogen.

HYDRO-SULPHURETS. See *Hydro-Sulphates* and *Sulphurets.*

HYDRURETS. (*Hydrures.*) Under this name are designated the solid products not acid, formed by a combination of hydrogen and a simple substance.

HYDRURET AMMONIACAL of MERCURY and POTASH. Thenard and Gay-Lussac have given this name to a compound, discovered by M. Seebeck, consisting of mercury, potassium, hydrogen, and ammonia. When into concentrated liquid ammonia is introduced a liquid amalgam of mercury and potash, or of mercury and soda, the amalgam increases greatly in volume, takes a butter-like consistence, and preserves its metallic brilliancy. According to Thenard and Gay-Lussac, the water of ammonia is decomposed, its oxygen unites to a portion of the potassium or sodium, in order to form potash or soda, which dissolves, while the hydrogen unites to the amalgam, thus forming the hydruret. (See *Traité de Chimie de M. Thénard.*)

HYDRURET of ARSENIC. (*Hydrure d'Arsenic.*) Reddish brown, solid, inodorous, insipid; it is not decomposed by red heat; it absorbs oxygen at a high temperature, becoming water and the deutoxide of arsenic. It is obtained by passing a little chlorine into flasks containing arseniuretted hydrogen; there is an immediate formation of hydro-chloric acid; at the same time the hydruret of arsenic is deposited on the sides of the vessel. Discovered and studied by Davy, Thenard, and Gay-Lussac.

Hydruret of Potassium. (*Hydrure de Potassium.*) Gray, solid, without a metallic appearance, is decomposed by a slow mild heat; all the hydrogen disengages, leaving the potassium free; mercury, assisted by heat, easily decomposes it; the hydrogen is disengaged, and the mercury amalgamates with the potassium. Discovered by Thenard and Gay-Lussac.

Hydruret of Sulphur. (*Hydrure de Soufre.*) A thick liquid, heavier than water, of an odour and taste analogous to sulphuretted hydrogen. It may be decomposed into sulphur and sulphuretted hydrogen; it is therefore supposed to be composed of two substances. It is obtained by pouring hydro-chloric acid into a solution of sulphuret of potassium; the hydruret of sulphur forms at the bottom of the vessel. It can be preserved only by mixing it with it a little hydro-chloric acid, and keeping it in a bottle closely corked.

Hydruret of Tellurium. (*Hydrure de Tellure.*) Discovered by Ritter; it is very little known; it is solid, and in appearance resembles the hydruret of arsenic. Its discoverer obtained it by attaching to the extremity of the negative wire of the voltaic pile a small fragment of tellurium, plunging this into water, and there forming a communication with the extremity of the positive wire. By the decomposition of water, hydrogen in a nascent state combines with tellurium.

Hygrometer. (From the Greek words *ugros* moist, and *metron* a measure.) An instrument to measure the degrees of moisture in the atmosphere.

Hypo. From the Greek *upo*, under, or less; thus, hypo-sulphuric acid contains less oxygen than sulphuric acid, &c. The opposite of *super*, above.

Hyosciamin. (*Hyosciamine.*) A name given by Brande to a substance which is obtained from the black hen bane (*Hyosciamus niger*) by means of potash, and by him believed to be of an alkaline nature.

I.

Indigo. Colouring matter, solid, without taste or odour, of a purple blue, volatilizes partially with heat, under the form of violet vapours similar to those of iodine. It neither dissolves in water, ether, or alcohol, except when the latter is heated. It dissolves by the aid of gentle heat in concentrated sulphuric acid; its use in dyeing is in part founded on this property. Nitric acid dissolves it easily. If by using deoxygenating substances a portion of oxygen is taken from indigo, it loses its fine colour, becomes yellow, and can then be easily dissolved in slightly alkaline water; if this solution is agitated in contact with the atmosphere, it regains the oxygen it had lost, and becomes blue. Sulphuretted hydrogen appears to be the substance which deoxygenates it with the most facility, acting upon it at the ordinary temperature. Indigo is extensively employed in dyeing; Gay-Lussac used it to determine with precision the degree of strength of the chloride of lime. It exists in the leaves of many species of plants, but is chiefly obtained from the *Indigofera tinctoria*. The leaves of this plant are fermented under water in large tubs; the liquor becoming acid, is covered with irised pellicles; it is then decanted, and mixed with lime water. A deposite is formed, which, when washed and dried, is the indigo of commerce. In order to obtain it perfectly pure, it should be heated in a closely covered silver crucible. It soon volatilizes, and deposites purple crystals. In this state it is composed of carbon 73·26, azote 13·81, oxygen 10·43, hydrogen 2·50. (*Leroger and Dumas.*)

Ink. (*Encre.*) Common ink is water which by means of gum holds in suspension a combination of tannin, gallic acid, and oxide of iron; this combination is easily obtained by macerating in a sufficient quantity of water equal parts of powdered nutgall and sulphate of iron, aftewards adding gum in suitable proportions.

Ink for Printing. (*Encre des Imprimeurs.*) A mixture of oil and lampblack.

Ink Sympathetic. (*Encre de Sympathie.*) Preparations for writing on paper, which become visible either by contact with some other substance, or by being heated. In the first case, if a solution of a salt of lead is used for writing, the letters are not visible until exposure to a sulphurous vapour renders them black. In the second case, a solution of hydro-chlorate (muriate) of cobalt being rose-coloured, cannot be seen upon rose-coloured paper, until the letters are heated; they then become blue.

Inulin. (*Inuline.*) A vegetable substance, white and pulverulent, presenting physical and chemical characters similar to starch. It however differs from it in some respects, as when dissolved in warm water it precipitates on cooling and does not become blue by the action of iodine. It was discovered by Rose in the parts of the elecampane, (*Inula helenium*) and has since been found in those of several other plants. It is obtained by making a strong decoction of the roots, leaving it to stand and then washing the deposite, which is inulin, with cold water.

Iodates. They are little soluble in water, most of them are wholly insoluble; all are decomposed by red heat, by sulphurous, sulphuric, and muriatic acids and powerful oxides, if not at the ordinary temperature, with a little increase of heat. In the iodates the quantity of the oxygen of the oxide is to the quantity of the oxygen of the acid as 1 to 5.

IODATE of AMMONIA. (*Iodate d'Ammoniaque.*) Gay-Lussac, to whom we are indebted for the discovery and study of its properties, obtained it by saturating iodic acid with liquid ammonia. It is precipitated in little granular crystals, which on burning detonate with a hissing noise, diffusing vapours of iodine.

According to this celebrated chemist, it is composed of iodic acid 100, ammonia 10·94, or in volume of 2 vol. of ammoniacal gas, 1 of vapour of iodine, 2·50 of oxygen.

IODATE of BARYTES. (*Iodate de Baryte.*) White, pulverulent, insoluble. It is obtained by double decomposition; it consists of 100 of acid, 46·34 of barytes.

IODATE of LIME. (*Iodate de Chaux.*) Crystallizes in small quadrangular prisms.

IODATE of POTASH. (*Iodate de Potasse.*) White, crystalline, fuses upon burning coals, dissolves in 14 parts of cold water; is formed of 77·754 of acid and 22·246 of the base. It is obtained by agitating a mixture of iodine and a solution of caustic potash with water. A very soluble hydriodate and an almost insoluble iodate are formed; this is purified with many washings with alcohol. In order to obtain it perfectly pure, it must be dissolved in boiling water; acetic acid is added to saturate an excess of alkali; it is then crystallized and the washings with alcohol repeated to carry off the acetate which may remain.

IODATE of SODA. (*Iodate de Soude.*) Crystallizes in little prisms, often in groups, presents similar characters to the iodate of soda, and is obtained in the same manner: it consists of 84·1 of acid and 15·9 of the base.

IODATE of STRONTIA, Dissolves with difficulty.

Iodine. A simple body, solid, brittle, of an odour analogous to chlorine, colour bluish gray, possesses a metallic lustre and a lamellar texture. Its specific gravity is 4·946.* It colours the skin a brownish yellow. Iodine is volatile; if submitted to the action of heat it melts at 224°. Its vapour is of a beautiful violet colour. It exhibits the electrical property of oxygen in a high degree; of course these two bodies cannot be directly combined. Its affinity for hydrogen, on the contrary, is very great; and it combines with most of the simple bodies. It decomposes water through the medium of an alkali, acts also upon the greatest part of hydrogenated substances. It unites with starch in different proportions, giving a beautiful blue colour to the combinations. For the discovery of this substance we are indebted to M. Courtois, a manufacturer of soda at Paris, but for the investigation of its properties to Gay-Lussac. It exists in sea-weeds and sponges. It is usually obtained from the mother-water furnished by the soda of sea-weed; these waters contain iodine united to hydrogen and potash; they are treated with sulphuric acid and the peroxide of manganese, the mixture being put into a retort and slightly heated iodine is deposited in the adopter and neck of the retort. It is purified by distilling it again with a mild alkaline water. It is employed in medicine and as a re-agent in chemistry.

Iodide of Ammonia. (*Iodure d'Ammoniaque.*) Was discovered by Colin. It is a viscous liquid, shining, of a darkish brown colour; in contact with water it is transformed into a soluble hydriodate and a fulminating iodide of azote which is precipitated. The iodide of ammonia is obtained by bringing ammoniacal gas in contact with iodine.

Iodide of Nitrogen. (*Iodure d'Azote.*) Pulverulent, dark brown, detonates by the slightest shock; it is obtained by treating iodine at the ordinary temperature with liquid ammonia, a soluble hydriodate of ammonia is formed, and iodine is precipitated. It is collected upon a filter, and is composed of 5·8544 iodine, 156·21 azote (nitrogen), or in volume of 1 of azote, and 3 of vapour of iodine.

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* According to Thompson it is 3·0844.

IODIDES METALLIC. (*Iodures Métalliques.*) Iodine combines with most of the metals; having considered the hydro-chlorates (muriates) as chlorides, and the hydrosulphates as sulphurets, we shall necessarily consider the hydriodates as iodides; according to Thenard the iodides which can dissolve in water become by this process hydriodates; according to Dulong many iodides can be dissolved in water without producing its decomposition. As all the phenomena which these bodies present may be explained according to either hypothesis, we use the terms hydriodates and soluble iodides as synonymous.

IODIDE of ANTIMONY. (*Iodure d'Antimoine.*) Is obtained by treating antimony with an excess of iodine. In contact with water it decomposes, giving place to hydriodic acid which dissolves, and the oxide of antimony which is precipitated; chlorine decomposes it at a high temperature; concentrated nitric acid disengages the iodine and the antimony is oxidized.

IODIDE of BARIUM. (*Iodure de Barium.*) Very soluble in water; crystallizes in acicular prisms. Exposed to an elevated temperature and submitted to contact with atmospheric air, it absorbs oxygen; the barium oxidizes, a portion of iodine is disengaged, and a sub-iodide of barytes is formed. Iodide of barytes is obtained by agitating iodine in a solution of barytes, filtering it in order to separate the insoluble iodate, and crystallizing the iodide (hydriodate); it is afterwards moderately heated to drive off the water of crystallization, which we must consider as combined with it if we regard it as a hydriodate.

Iodide of Bismuth. (*Iodure de Bismuth.*) Is obtained like that of antimony, or rather by pouring a solution of the iodide of potassium into a solution of the nitrate of bismuth; nitric acid drives off the iodine and forms a nitrate.

Iodide of Calcium. (*Iodure de Calcium.*) Very soluble in water, susceptible of crystallization; it is obtained by a process similar to that of the iodide of barium, and is affected by heat in the same manner.

Iodide of Copper. (*Iodure de Cuivre.*) Little known; it may be prepared either directly or by double decomposition.

Iodide of Iron. (*Iodure de Fer.*) Brown, styptic, very soluble; may be prepared directly, or rather by bringing iron and iodine in contact, at the ordinary temperature, through the medium of water.

Iodide of Lead. (*Iodure de Plomb.*) Little known, is obtained by pouring a solution of the iodide of potassium into a solution of the acetate.

Iodide of Mercury. (*Iodure de Mercure.*) Mercury combines with iodine in two proportions: *Proto-iodide* is of a greenish yellow colour, insoluble in water; it is obtained by pouring a solution of the iodide of potassium into a solution of the proto-nitrate of mercury, filtering and washing the precipitate. *Deuto-iodide* is of a beautiful red, fusible and susceptible of volatilizing; it is then lamellar and very brilliant, and is obtained by pouring a solution of the iodide of potassium into a solution of the deuto-chloride of mercury. It is employed in medicine.

Iodide of Potassium. (*Iodure de Potassium.*) Colourless, susceptible of crystallization, fusible, and volatile above red heat; very soluble in water, decomposable by nitric and sulphuric acids. It is formed of 100 of mercury and 20·425 of iodine. It is obtained by agitating iodine in a solution of caustic potash, filtering it and evaporating the liquor.

Iodide of Silver. (*Iodure d'Argent.*) It is obtained like that of antimony, is insoluble in ammonia, has no action upon water, is decomposed by chlorine, by nitric, and concentrated sulphuric acids.

Iodide of Sodium. (*Iodure de Soude.*) Colourless, very soluble in water, crystallizes in rhomboidal prisms which contain much of the water of crystallization; it loses this water on being exposed to heat, fuses and volatilizes. It is obtained like the iodide of potassium.

Iodide of Strontium. (*Iodure de Strontium.*) Very soluble, crystallizes in acicular prisms; exposed to the action of caloric, it exhibits the same phenomena as the iodide of barium, and is obtained in the same manner.

Iodide of Tin. (*Iodure d'Etain.*) Is prepared like that of antimony, and possesses similar properties.

Iodide of Zinc. (*Iodure de Zinc.*) Is obtained by heating zinc with an excess of iodine, or by boiling water with iodine and an excess of this metal; afterwards heating the uncrystallizable liquor which resulted from the first operation; when it has lost its water of crystallization it volatilizes, and crystallizes in very fine colourless prisms; but if heated in contact with the air, it is transformed into iodine and an oxide of zinc.

Iridium. This, of all metals, combines with other substances with the greatest difficulty; it is a white metal, not fusible; its density is not known, it has hitherto been combined with but a small number of substances. Nitro-muriatic acid does not act upon it; potash acts upon it at a very high temperature. It is a very rare substance, and has been found only in combination with osmium in platina ore. (See *Platina.*)

Iron. (*Fer.*) A metal of a bluish gray colour, sometimes granular, sometimes lamellar, very ductile and malleable. It has great tenacity, is very magnetic; its specific gravity is 7·788. It melts at a high temperature. Its affinity for oxygen is such that at a high temperature it takes it from potassium and even sodium, and form many oxides even at at the ordinary temperature. It i the only metal that has hitherto been combined with carbon; this combination is called plumbago; steel is a per-carburet of iron. Iron combines with most combustible non-metallic substances, and forms alloys with many metals; it decomposes water at the ordinary temperature, only in proportion as this water contains air or oxygen; a low oxide is thus formed, which by its contact with the metal appears to develope sufficient electricity to continue the decomposition. Nitric acid dissolves it, producing a certain quantity of the nitrate of ammonia. The solution of the protoxide of iron forms with the alkalies a white precipitate which becomes green by contact with the atmosphere, afterwards a darker green, and then red. It forms with the ferruretted hydro-cyanate of potash, a white precipitate which becomes blue by contact with the air; it is not precipitated by nutgalls, but the solution is coloured by the air a violet blue. At the second degree of oxidation the solution of iron is precipitated dark green by the alkalies, sky blue by the hydro-cyanate of potash, and deep blue by nutgalls. Iron is found in nature in various states; those in which it is wrought are native iron, carbonated, oxidulated, oligist, hematite, &c. It is found combined with sulphur and arsenic in the state of a salt, but these last two minerals are not wrought. In order to obtain iron from its combinations, the ore is roasted, or pulverized when it is earthy, and treated with charcoal at a very high temperature, in the peculiar furnaces, called *hauts fourneaux*. When the mineral is siliceous, carbonate of lime is added (called *cussine*) in order to facilitate the fusion; but if silex is wanting, an argillaceous solvent (called *erbue*) is added; in proportion as the iron is reduced it passes into the crucible or lower part of the high furnace; and when this part is filled, the melted matter flows into a channel made in the sand, and the elongated mass which results is called the *gense*, or melting; this is exposed to a very high temperature in order to burn a little carbon which it contains, and to reduce a quantity of oxide; it is many times successively hammered, in order to separate the vitrified matter (*laitier*) which is coloured green by the oxide of iron.

Iron White. (*Fer blanc.*) Ancient name for tin.

J.

Jelly Vegetable. (*Gelée Végétale.*) Vegetable jelly. A colourless substance, of an appearance similar to gum, soluble in hot water, and almost insoluble in cold. It exists abundantly in some fruits, such as apples, cherries, currants; &c; it is very difficult to obtain it in a state of purity, as a little of the colouring matter of the fruits is always retained. By being left too long in contact with boiling water, it loses its gelatinous appearance. It appears to contain a little nitrogen, which may be owing to the small quantity of yest (ferment) which jelly contains.

Jet. (*Jais.*) So called from the river Gaza in Asia, from whence it came. It is a black bituminous coal, hard, compact, found in great abundance in various parts of France, Sweden, Germany, and Ireland. It is brilliant and vitreous in its fracture, and capable of taking a good polish by friction; it attracts light substances, and appears electric, like amber; hence it has been called *black amber*.

Jupiter. A name given by the ancient chemists to tin, because supposed to be in some measure, under the influence of that planet.

K.

Kali. (An Arabian word.) See *Potash.*

Kelp. Incinerated sea-weed.

Kermes. See *Hydrated Sulphate of Antimony.*

Kinates. Combinations of kinic acid with bases. These salts are scarcely known, they are not used.

Kinine. See *Quinine.*

Kino. A resin obtained from a tree growing in Africa; it resembles in appearance the resin called dragon's blood (*Sanguis draconis.*) It is considered one of the most efficacious astringent medicines of the vegetable kingdom.

L.

Laboratory. (*Laboratorium.* From *labor,* labour.) In chemistry it signifies a place properly fitted up for the performance of chemical operations.

Lac. (From *Lac, lactis*) Milk. Also a vegetable substance, obtained from a plant* in the East Indies; it is sometimes called *gum-lac, stick-lac, shell-lac,* &c.

Laitier. A name by which the French understand the vitrified matter which is found on the surface of iron, in a state of fusion.

Laiton. *Brass.* An alloy of copper with zinc.

Lamp Philosophic. The old chemists gave this name to the burning hydrogen gas which they caused to issue from a matrass, through a small straight tube; when the hydrogen gas had driven the atmospheric air from the matrass, they applied a lighted taper to the gas; this formed a lamp which burnt until all the gas was disengaged.

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* *Croton lacciferum;* or Croton, bearing *lac.*

his experiment is made with iron filings, and diluted lphuric acid, the same as in obtaining hydrogen gas.

Lead. (*Plomb.*) A metal of a bluish white colour, rilliant, giving a disagreeable odour on rubbing; the pecific gravity is 11·352. Lead is malleable and ductile. ut it posesses little tenacity, very little elasticity and is ttle sonorous. It is one of the most fusible of metals. t melts much below red heat, and crystallizes on cooling. tmospheric air and dry oxygen gas have no action upon it; but if these gases are humid, they soon tarnish it, covering it with a gray crust of the protoxide of lead; at a high temperature it absorbs the oxygen of the air; in fusion it is covered with a yellow crust, which is soon replaced by a second, if this is removed. Boron, hydrogen, nitrogen, and carbon have no action upon lead; but it combines easily with phosphorus, sulphur, iodine, chlorine, selenium, and many other metals. Lead was known in the most ancient times; on account of its abundance in nature, it has been the object of many investigations; the alchemists tortured it in the hope of transforming it into silver; they called it *Saturn*. It is found in nature in three states: 1st, in the state of a salt; 2d, as an oxide combined with sulphur; 3d, in a native state.

In the arts lead is obtained by the following process: the sulphuret of lead or *galena* is pulverized and washed to separate it from its gangue; the gangue broken in pieces, washed, and roasted; by this operation one part of the lead oxadizes and combines with the sulphuric acid formed by the combustion of the sulphur; when the mineral is a powder (*schlichs*) it is mixed with clay, the roasting is repeated many times in order to decompose the galena: the mineral is melted in the furnace with charcoal, the lead oxidizes and is reduced; the sulphate of lead is changed to a sulphuret; masses are formed which must be again roasted and melted until they contain no sulphur. When lead contains sufficient silver t be extracted with advantage it is separated by cupellation. Lead on account of its abundance, and the facility with which it is wrought, is much employed in the arts; it is used for many domestic utensils, for cannon balls and ammunition of various kinds, for water spouts, reservoirs, chambers for the manufacture of sulphuric acid, for printing types, &c. It is employed in some medicinal preparations.

Lead Horned. (*Plomb corné.*) Ancient name for the chloride of lead.

Lignin. An insipid substance without odour, insoluble in water, alcohol, and weak acids. It exists abundantly in plants, forming their woody fibre.

Lilium of Paracelsus. *Lily of Paracelsus.* By this name was formerly designated a solution of caustic potash in alcohol; this preparation for a long time was greatly celebrated. It was prepared by melting in a crucible 2 parts of the martial regulus of antimony, 1 part of fine tin, and 1 part of molten copper; the alloy which resulted was pulverized, mixed with 3 times its weight of purified nitre; this mixture was then gradually thrown into a crucible, and heated to redness, thus detonating, calcining, and melting, until all the metals were oxidized; the mixture was then taken from the fire, and immediately reduced to powder in a heated iron mortar; rectified alcohol was then added while the powder was hot; after standing some days the liquor appeared of an intense red; it was then decanted and preserved in bottles closely stopped. Paracelsus, and some others, thought that alcohol could extract some peculiar virtue from metals; they thus called this liquor *tincture of metals;* or lily of Paracelsus; this error was exposed by Baron and Baume, who demonstrated that this metallic tincture was only a solution of potash in pure alcohol.

Liquor Fuming of Boyle. A name formerly given to the hydroguretted sulphuret of ammonia on account of its property of diffusing white vapours in the air, as soon as brought into contact with this fluid.

Liquor Fuming of Cadet. A yellow fuming liquor, oily, of an insupportable odour, which Thenard considered as a species of oleo-arsenical acetate, containing pyro-acetic acid. Cadet discovered this liquid by heating in close vessels equal parts of the acetate of potash and the deutoxide of arsenic; in this operation, besides this liquid, are also obtained carbonic acid gas, carburetted hydrogen, arsenuretted hydrogen, and another liquid and volatile product of a brownish yellow, lighter than the first liquid, from which it also differs by containing water and acetic acid..

Liquor of Flints. (*Liquor des Cailloux.*) Solution of silicated potash. It is prepared by pulverizing quartz or other silicious stones, mixing the powder with 3 or 4 parts of the sub-carbonate of potash; this mixture is by degrees thrown into a crucible highly heated; the mixture is kept in a state of fusion for half an hour; it is then poured out upon oiled marble, and in a concentrated state preserved in a closely stopped flask, or dissolved in water, and the solution kept from contact with the air.

Liquor of Hoffman. This mineral anodyne is ethereal alcohol, prepared by mixing equal parts of alcohol and rectified sulphuric acid.

Liquor of Lampadius. See *Carburet of Sulphur*.

Liquor of Libavius. See *Deuto-Chloride of Tin*.

Litharge. (From *lithos* a stone, and *arguros* silver.) A name formerly given to the deutoxide of lead.

Lithia. See *Oxide of Lithium*.

Lithium. The metallic basis of lithia, an oxide discovered by M. Arwedson, a young man employed in the laboratory of Berzelius. Thenard supposes that lithium may be obtained in a manner analogous to calcium, and that it possesses similar properties,

Litmus. A beautiful blue prepared from a white lichen, (*Lichen rocella.*) It is an excellent test for acids and alkalies. Paper dipped in an infusion of litmus, and called litmus paper, is much used as a test.

Liver of Antimony. A mixture of the oxide and sulphuret of antimony. It is obtained by burning a mixture of equal parts of nitre and the sulphuret of antimony.

Liver of Sulphur. A name given by the ancient chemists to the alkaline sulphuret of potash.

Lixiviation. The application of water to the fixed residues of bodies, for the purpose of extracting the saline part.

Lixivium. A solution obtained by lixiviation.

Lune. (*Moon.*) A name sometimes given to silver; thus the nitrate of silver is called *lunar caustic.*

Lune Corne'e (*Horned Moon*) of **Ludemann.** In some ancient works the oxide of tin is known under this name.

Lupulin. Solid, very bitter, soluble in water, alcohol, and ether. It is obtained from the membranous scales of the pistillate flower of the hop. It was discovered at the same time by Dr. Ives, Planche, Chevalier, and Payen.

Lutes. Substances applied in layers more or less thick upon the surface of bodies, in order to preserve them from the too powerful action of fire or from the air, and also to fill up the interstices of vessels. A very common lute is of starch and the flour of flax-seed; a soft paste is made with these substances, which is used for covering around the stoppers fitted to retorts, matrasses, &c.; another lute is prepared by pulverizing very dry potters' clay, and mixing it with a suitable quantity of oil; this resists the action of corrosive substances, but has the inconvenience of being softened by heat.

Lute of Clay and Sand. (*Lut d'Argile et de Sable.*) Glass and stone retorts should be luted with a compound ual parts of sand and clay mixed with water and

TE of the WHITE of EGGS and LIME. (*Lut de*
c *d'Œuf et de Chaux.*) Is sometimes used to fill up
ies made by the joining of different parts of an appa-
. It is prepared by diluting powdered quicklime
the whites of eggs, and applying it as soon as pre-
l.

MPH. Liquid, opaline, of a reddish tint, sometimes
wish. It has a salt taste, does not redden the tinc-
of litmus, and greens a little the infusion of violets.
reul has found it to consist in 1000 parts: Of

926·4	of water,
4·2	fibrin,
61·0	albumen,
6·1	muriate of soda,
1·8	carbonate of soda,
·5	phosphate of lime,

e magnesia and carbonate of lime. Lymph is con-
l in the lymphatic vessels of animals.

M.

CERATION. (From *macero*, to soften by water.)
peration which consists in the infusion of substances
ld water, in order to extract their virtues; it differs
digestion only as the latter operation admits of the
cation of heat.* Maceration is preferable in all
where heat would be injurious; as in volatile and
atic substances, &c.

DDER. A substance extensively employed in dyeing;
he root of the *Rubia tinctorum*.

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difference is here made by the French chemists which is not observed by
glish, who appear to use the words *maceration* and *digestion* as syno-
s.

Madrepores. A species of coral, the zoophyte of naturalists. They consist of lime and a little membranous animal substance.

Magistery. (*Magisterium*; from *magister*, a master.) The ancient chemists used this term for preparations which they thought were made in a masterly or wonderful manner; as the magistery of bismuth, sulphur, &c.

Magistery of Bismuth. A name formerly given to the sub-nitrate of bismuth.

Magistery of Sulphur. Some ancient chemists gave this name to the sulphur which they precipitated by pouring acetic acid into the solution of a soluble sulphuret. Sulphur precipitated in this manner is almost white, being in the state of a hydrate, and not that of an oxide, as some chemists have supposed.

Magnesium. See *Oxide of Magnesium.*

Magnesia Black. (*Magnésie Noire.*) A name given by some chemical authors to the black oxide of manganese; it has more recently been given to pulverized vegetable charcoal.

Magnesium. The base of magnesia; discovered by Davy.

Magnet. (*Aimant.*) (From *Magnes*, the discoverer.) The loadstone. It is known by its property of attracting steel and iron; it is found in Spain, Sweden, and Siberia. It is an iron ore composed of 72 of metal and 28 of oxygen, or rather of 69 of the tritoxide of iron and 31 of the deutoxide; its specific gravity is 4·24. A fragment of this metal, if placed upon a pivot, always points to the north and south, being always provided with two poles. For its chemical characters, see *Oxide of Iron.*

Magnetism. The property which iron possesses of attracting or repelling other iron or steel according to circumstances; that is, similar poles of magnets repel but opposite poles attract each other.

Malates. Combinations of malic acid with salifiable bases: all these salts expand and decompose by fire, giving products analogous to other vegetable substances; most of the malates are soluble, or become so by an excess of acid; they are all products of art, most of them being prepared by directly combining malic acid with the metallic oxides. According to Braconnot, in the malates the oxygen of the oxides is to the acid as 1 to 9·09.

Malleability. (From *malleus*, a hammer.) The property which several metals possess of being extended under the hammer in thin plates, or laminæ, without cracking. The thin plates of gold and silver are the best examples of malleability.

Maltha. A kind of mineral tallow found on the coast of Finland.

Manganese. A whitish gray metal, very hard and brittle. Its specific gravity is 6·85;* it is of all metals one of the most difficult to melt, fusing but at 160° of Wedgewood's pyrometer. At the ordinary temperature it has no action upon atmospheric air, or oxygen gas; but if the temperature is elevated it soon oxidates. It decomposes water at red heat; yet according to Thenard, if finely pulverized manganese is put into water at the ordinary temperature, the metal after some time tarnishes, and a little hydrogen is disengaged. Hydrogen, nitrogen, boron, and carbon, have no action upon this metal; it has not yet been ascertained what would be the effect of iodine and silicium upon it. With much difficulty sulphur has been made to combine with it, although a natural sulphuret exists. At a high temperature it combines with phosphorus, forming a white and brilliant phosphuret, which becomes a phosphate when heated in the air or with oxygen. It absorbs chlorine rapidly, forming a very soluble greenish chloride. Manganese was discovered by Scheele in 1774; but Gahn first obtained it in the metallic state. Manganese exists abundantly in nature; it is found in the state of a phosphate or a sulphuret, but most commonly as an oxide. It is extracted from the oxide; for this purpose it is mixed with equal parts of lamp-black, (*noir de fumée*,) and made into a paste by the addition of oil; it is then formed into a ball and put into a crucible lined with powdered charcoal, the mixture also being covered with charcoal; the crucible is then covered and exposed to the most intense heat for two hours; on cooling, metallic masses will be found mixed with the charcoal at the bottom of the crucible. (*Thenard.*)

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* Dr. Ure states its specific gravity at 8·0.

Manna. (From MANO, a gift, Syrian; it being the food given by God to the children of Israel in the wilderness.) Several vegetables afford manna, but principally the ash, (*Fraxinus ornus*;) it has a sugar-like and fresh taste; it crystallizes in little compact needles, is very soluble in water, is little affected by the air, except in being a little yellowed; it decomposes by fire, like other vegetable substances; nitric acid changes it into oxalic acid. It does not furnish alcohol by fermentation, and is not precipitated by the acetate of lead. The mannite exists in manna; Vogel has obtained it from the leaves of the celery; Braconnot in the sugar of the red beet; and M. Guibourt in honey. The most easy mode of obtaining it is to dissolve manna in boiling alcohol; the liquor is filtered while hot, and on cooling the mannite is precipitated; it may be redissolved in order to obtain it in a state of greater purity.

Marble. See *Oxide of Calcium.*

Margarates. Combinations of margaritic acid with salifiable bases. The salts resulting from this union bear a great analogy to the stearates, from which they are scarcely distinguished, the principal difference being that the neutral margarate and the acid margarate of potash are much more soluble in alcohol than the stearates of the same base. (See *the works of M. Chevreul.*)

Margarine. A name formerly given to margaritic acid.

Mars. A name given by the ancient chemists to iron.

Massicot. Deutoxide of Lead.

Matter Colouring of Leaves. See *Chlorophylle.*

Matrix. (*Gangue.*) The earthy or stony matter which accompanies ores, or envelopes them in the earth.

Matrass. A glass vessel, either round or flat at the bottom, with a long neck, and usually furnished with one or more tubulures.

Mellates. (*Mellitates.*) Combinations of mellitic acid with salifiable bases. These salts have been but imperfectly studied; those of potash, soda, and ammonia, are known to be soluble and crystallizable; the first crystallizes in long clustered prisms, and precipitates the solution of alum; the second crystallizes in cubes, and the last in beautiful six-sided prisms, which are at first transparent, but become of an opaque white on exposure to the air.

Melting. Synonymous with fusing. Change of state effected by caloric.

Menstruum. A word synonymous with solvent. The principal *menstrua* made use of in pharmacy, or the preparation of medicines, are vinous spirits, oils, acids, and alkaline liquors.

Mercury. (*Mercure.*) Is a metal of a bluish white colour, liquid at the ordinary temperature; its density is 13·568. It boils at 642°, is reduced to vapour, and condenses in a receiver fitted to the neck of the retort. It volatilizes a little, even at the ordinary temperature, as has been demonstrated by Faraday. By exposing for some time over a vessel of mercury a leaf of gold, it will be found sensibly whitened. Exposed to a cold of from

—39° to —40°, mercury solidifies and crystallizes in octoedrons. In order to produce this degree of cold, 2 parts of chloride of sodium, (common salt,) with one part of snow, are mixed; and into a vessel containing this mixture a matrass containing mercury is introduced; this in a few minutes will begin to solidify. Thus congealed, it is malleable; if applied to the skin in this state, it will produce a sensation no less painful than that of red hot iron; whitening the point touched, and producing disorganization, if the painful contact be prolonged. This metal at the ordinary temperature has no action upon atmospheric air, or oxygen gas; but at the temperature of boiling heat, it gradually becomes a red oxide; this the ancient chemists called *precipitate per se.* Mercury does not combine with hydrogen, boron, carbon, or nitrogen; its union with phosphorus is still doubtful; but it easily combines with chlorine, sulphur, selenium, iodine, and many of the metals; the alloys formed by it with the latter are called amalgams.

The discovery of mercury is of the highest antiquity; this metal was of all others the most tortured by the alchemists; they imagined it was liquid silver, and by solidifying it would form that metal. They thought, that in order to bring mercury to a solid state, it must be heated for a long time. Boerhaave, who laboured upon this metal with a patience almost unparalleled, held it in digestion for twelve successive years, but without any visible alteration. He thus demonstrated the absurdity of their attempts to bring it to silver by that method. The alchemists in their vain attempts to make of mercury something for which nature had not designed it, discovered many medicines which are of great importance in the *materia medica.* The uses of mercury are very numerous in the arts as well as in medicine. It is usually extracted by heating the sulphuret mixed with lime in a galley furnace; the lime unites with the sulphur of the sulphuret; the mercury volatilizes, and condenses in the receiver.

Mercurius Dulcis. (*Mercure Doux.*) *Calomel.* See the *Proto-Cloride of Mercury.*

Mercury Fulminating. The ammoniuret of mercury.

Mercury Soluble of Hahnemann. See *Nitrate of Mercury.*

Mercurification. An ancient operation of alchemy by which the professors of this science pretended to reduce all the metals into one metallic liquor; or according to them, to draw from metals their mercurial principle. Among the books of some ancient writers may be found many processes for this purpose. One of the alchemists, Teichmeyer, even asserted, that if iron filings were for a year exposed to the atmosphere, afterwards well triturated in a mortar, left to stand another year in the air, and then submitted to distillation in a retort, they would furnish some mercury; this error might have been caused by the circumstance of some alchemists happening to distil as iron, metallic oxides, which, unknown to them, contained a little mercury.

Metals. (*Metaux.*) They are elementary bodies almost wholly opaque, very brilliant in masses, and possessing this property even when pulverized; they are susceptible of a polish more or less bright according to their nature. They are good conductors of caloric and electricity; are capable of combining with oxygen and of forming oxides which have a metallic appearance, and which by uniting to acids saturate them and form salts. Of all substances in nature none have so much attracted the attention of chemists as the metals. To how many experiments did the alchemists not subject them, that they might discover *the grand secret,* (*grand œuvre,*) the philosopher's stone? They believed that by some hidden process even the basest metal might be converted into gold and silver; they laboured with such zeal and perseverance that many, animated with indefatigable courage, sacrificed their fortunes and lives to this delusion. They pretended even to have discovered immortality, when Paracelsus, the leader of this sect, who boasted the possession of the secret, died at the age of 48 years. From so many labours we have derived some advantages; metallurgic chemistry owes many of its discoveries to the alchemists. Yet they were far from knowing all the metals, for in the fifteenth century were known only gold, silver, iron, copper, lead, mercury, and tin, and now we reckon 41.

Among the various classifications of metals made by chemists, that of Thenard is the most scientific.

TABLE OF THE DISCOVERY OF METALS.

Names of Metals.	Discoverers.	Period of their discovery.
Gold,	Known from the earliest periods.	
Iron,		
Silver,		
Copper,		
Mercury,		
Lead,		
Tin,		
Zinc,	Discovered by Bombast Parulo, in	1541
Bismuth,	Described by Agricola, in	1520
Antimony,	Described by Basil Valentine,	15th century.
Arsenic,	Brandt,	1733
Cobalt,		
Platina,	Wood, an assayer at Jamaica,	1741
Nickel,	Cronstedt,	1751
Manganese,	Gahn, Scheele,	1774
Tungsten,	D'Elhuyart,	1781
Tellurium,	Muller,	1782
Molybdenum,	Suggested by Scheele and Bergman, discovered by Hielm,	1782

Names of Metals.	Discoverers.	Period of their discovery.
Titanium,	Gregor,	1787
Uranium,	Klaproth,	1789
Chromium,	Vauquelin,	1797
Columbium,	Hatchett,	1802
Palladium, Rhodium,	Wollaston,	1803
Iridium,	Descotils, Vauquelin, Fourcroy, Smithson, Tennant,	1803
Osmium,	Tennant,	1803
Cerium,	Berzelius and Hisinger,	1804
Potassium, Sodium, Barium, Strontium,	Davy,	1807
Cadmium,	Hermann and Stromeyer,	1818
Lithium,	Arfwedson,	1818
Silicium,[*] Zirconium,	Berzelius,	1824
Pluranium,	Osann,	1828
Aluminum, Glucinum, Yttrium,	Wohler,	1828

Thenard divides the metals into six sections, founded upon their affinity more or less great for oxygen. In his first section he places those which have not been reduced, and which are admitted only by analogy. They are seven :

1st Section. Magnesium,
Glucinum,
Yttrium,
Aluminum,
Thorinium,
Zirconium,
Silicium.

In the second section he places those which absorb oxygen gas at the highest temperature, and which possess the property of suddenly decomposing water at the ordinary temperature by uniting with its oxygen and disengaging the hydrogen with a lively effervescence. These metals are the six following:

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[*] *It seems doubtful whether this substance should rank among the metals, being deficient in metallic lustre, and not a conducter of electricity.*

2d Section. Calcium, Lithium,
Strontium, Sodium,
Barium, Potassium.

In the third section he places the metals which absorb oxygen at a very high temperature, but which do not decompose but at a red heat, these are the five following:

3d Section. Magnesia, Tin,
Zinc, Cadmium.
Iron,

The fourth section is composed of all the metals which like the preceding absorb oxygen at a very high temperature, but which do not decompose water, even with the aid of heat. This division contains the fifteen following:

4th Section. Acidifiable { Arsenic, Cerium,
Molybdenum, Cobalt,
Chromium, Titanium,
Tungsten, Bismuth,
Columbium, } Copper,
Antimony, Tellurium,
Uranium, Nickel,
Lead.

Thenard also forms of the fourth a sub-section, in which he places the first five, which are acidifiable.

The fifth section is formed of such metals as absorb oxygen gas but at a certain heat, which cannot decompose water and whose oxides are reduced but at a high temperature; there are two metals of this kind:

5th Section. Mercury, Osmium.

The sixth and last section comprises the metals which cannot absorb oxygen gas and decompose water at any temperature, and whose oxides are reduced but at red *heat.* There are six metals in this section:

6th Section. Silver,
Palladium,
Rhodium,
Platina,
Gold,
Iridium.

The physical characters of the metals are, *lustre, hardness, opacity, colour, density, ductility, malleability, tenacity, elasticity, sonorousness, specific gravity, taste, odour,* and *structure. Lustre* (*eclat*) is the property which metals possess, even when pulverized, of reflecting a great quantity of light; such as possess this property in a high degree, are gold, silver, iron, platina, palladium, tin, &c.

Metals vary much as to their *hardness*, some possessing this quality so as to cut most substances, others being so soft as to be divided with the finger nail. Thomson has stated the hardest metals to be, tungsten, palladium, manganese, iron, nickel, platina, copper, silver, gold, bismuth, cobalt, tin, lead, &c.; from this statement one might conclude that the metals are hard in proportion as they are difficult to fuse.

The metals are *opaque*, but this opacity does not appear to be absolute, for a leaf of gold transmits some luminous rays, and as next to platina this is the most dense metal, it would appear that no metal is wholly opaque.

The *colour* of metals is very different, although there are but two or three principal colours. The following table exhibits their various shades:

COLOURS OF METALS.

Silver (*Argent*)	White.
Tin (*Etain*)	Silver white.
Platina (*Platine*)	do.
Aluminum	do.
Palladium	do.
Nickel	Pale white.
Mercury (*Mercure*)	White, slightly azure.
Iridium	do.
Tellurium (*Tellure*)	do.
Cadmium	Silver white.

Antimony (*Antimoine*)	The same with a bluish reflection.
Cobalt	Grayish white.
Potassium	Whitish gray.
Sodium	
Manganese	Gray of polished steel.
Arsenic	
Rhodium	do.
Cerium	
Lead (*Plomb*)	Slaty white.
Zinc	do.
Bismuth	Yellowish white.
Iron (*Fer*)	Gray.
Molybdenum (*Molybdine*)	Dark bluish gray.
Uranium (*Urane*)	
Osmium	Bluish black.
Gold (*Or*)	Yellow.
Copper (*Cuivre*)	Reddish.
Titanium (*Titane*)	do.
Glucinum	Deep gray.
Yttrium	do.

Density, or specific gravity, is a property which was long believed essential to metal. Before the discovery of potassium, it was believed that the metals were the most dense, and of course the most heavy of all bodies in nature; platina is indeed more than 22 times as heavy as water, but potassium is lighter than water, since it swims upon this liquid. The property of density has now ceased to be characteristic. The following table from Thenard exhibits the relative density of metals:

TABLE OF THE SPECIFIC GRAVITY OF THE METALS.

Metals.	Specific Gravity.	Authorities.
Platina	20·98	Brisson.
Gold	19·257	Brisson.
Tungsten	17·6	D'Ethayart.
Mercury	13·568	Brisson.
Palladium	11·8	Wollaston.
Lead	11·352	Brisson.
Silver	10·4743	
Bismuth	9·822	

Metals.	Specific gravity.	Authorities.
Uranium	9.	Bucholz.
Cobalt	8·5384	Hauy.
Copper	8·895	Hatchett.
Cadmium	8·604	Stromeyer.
Arsenic	8·308	Bergmann.
Nickel	8·279	Richter.
Iron	7·788	Brisson.
Molybdenum	7·400	Hielm.
Tin	7·291	Brisson.
Zinc	6·861	Brisson.
Manganese	6·850	Bergmann.
Antimony	6·7021	Brisson.
Tellurium	6·115	Klaproth.
Titanium	5·300	Wollaston.
Sodium	0·972	Davy, Gay-Lussac, and Thenard.
Potassium	0·865	
Cerium	4·489	Hisinger and Berzelius.

By *ductility* is meant the property which many metals ssess of being drawn out into fine wire. When they n be extended under the hammer, or spread out into in leaves, this property is called malleability; it is very fferent from ductility, for those metals which can be st drawn into wire, are not always those which can be ade into leaves, as iron, for example.

The greater weight a metal drawn into wire is able to stain, the greater is its *tenacity*. Such as possess this operty in the greatest degree are iron, copper, platina, lver, gold, tin, zinc, &c.

The *elasticity* and *sonorousness* of metals are always in oportion to their hardness; it is for this reason, that in der to increase these properties, metals are often comned with such substances as will render them harder. or example, iron combined with charcoal is harder and ore elastic than iron alone; tin alloyed with copper is arder and more sonorous than either of these metals efore they are combined.

Taste and *odour* are properties inherent in some metals. Copper has a very disagreeable taste and odour; iron, tin, and lead have peculiar tastes; gold and silver, upon being rubbed, are insipid and inodorous.

By *structure* is understood the tissue or arrangement of the integrant parts of a metal; sometimes it is fibrous, sometimes granular, &c.

The *chemical properties* of the metals are not less interesting than their physical properties. 1st. *Action of fire;* exposed to the action of fire, metals fuse at very different temperatures, some fusing at less than red heat, others but at the highest degree of heat, and some are almost infusible at any temperature. When a metal is in a state of fusion, if the crust formed upon the surface is pierced and the liquid part decanted, it is obtained crystallized. When metals are submitted to a heat greater than is necessary for its fusion, a small number volatilize.

M. Children, who has made a long series of experiments upon the action of *electricity* with respect to metals, has demonstrated that its action has a great resemblance to that of caloric, only that it acts in a more energetic manner; causing the fusion of those metals which have resisted the most powerful application of caloric, burning with facility the wire of platina, gold, iron, &c.

Oxygen also produces with metals important phenomena, some absorbing it at the ordinary temperature, others but at the most elevated temperature; sometimes disengaging caloric and light, though usually this phenomenon does not accompany the combination of oxygen with the metals. Some metals do not combine with oxygen at any temperature. Most simple substances, not metallic, form with oxygen peculiar compounds.

The immortal Lavoisier first proved, that when the acids unite with metals, they are burnt, or what is the ame thing, transformed to oxides. It follows then that whenever an acid is brought in contact with a metal, the atter burns at the expense of the oxygen of the acid, or y absorbing the oxygen of the water and disengaging hydrogen.

Milk. (*Lait.*) An opaque liquor, white, opaline, heavier than water, of a sweet and sugared taste. When this liquor is evaporated, it forms a pellicle which is soon replaced by another, if the first is removed. If submitted to distillation, it furnishes a liquid which contains a certain quantity of milk. Milk left to itself at the ordinary temperature, separates into serum or whey, caseous matter, and cream. The cream, which contains much butter, on account of its specific levity, rises to the surface; it is yellowish white, of a sweet and agreeable taste. The serum or whey, is a transparent, greenish yellow liquid, composed of much water, sugar, milk, and many salts; it also contains acids, as it reddens litmus. According to Gay-Lussac, milk may be preserved many months by heating it a little every day. Milk mixes with water in all proportions; all the strong acids, unite with its caseum. Alcohol coagulates milk, but acts with it in a manner different from the acids, having no action upon its caseous matter; it acts upon it by uniting with the water of the milk. The acetate of lead, and perhaps some other salts, coagulate milk; potash, soda, and ammonia redissolve the coagulum formed by acids. According to Fourcroy and Vauquelin, cow's milk is composed of a great quantity of water, acetic acid, sugar of milk, a substance analogous to gluten, muriate of potash, fluate of potash, and muriate of soda.

Berzelius has made the following analysis of cow's milk: In 1000 parts, from which the cream had been taken off, he found

Water,	928·75
Some traces of butter and caseum	28·00
Sugar of milk,	35·00
Muriate of potash,	1·70
Phosphate of potash,	0·25
Lactic acid, acetate of potash, with one atom of acetate of iron,	6·00
Earthy phosphate,	0·50

Mine de Plomb Noire. (*Black Lead ore.*) A name formerly given to the per-carburet of iron.

Mine de Plomb Rouge. (*Minium*, Latin.) Red lead. See *Tritoxide of Lead.*

Miraculum Chimicum. The ancient chemists gave this name to a solid compound, which they obtained by mixing equal parts of the liquid sub-carbonate of potash and the deliquesced chloride of lime. By their mixtures, hard and stony matter was instantly formed. It is evident that here was a double decomposition; the product of which was a sub-carbonate of lime and chloride of potassium.

Mofette Atmosphe′ri′que. A name sometimes given to azotic (nitrogen) gas.

Molecules. In chemistry, by the term molecules, is understood very minute homogeneous particles, invisible on account of their great tenuity, which by their union form substances. When the body is elementary, all the molecules are the same; they are then called integrant molecules, atoms, or particles; thus in a piece of sulphur, all the molecules are integrant molecules, a compound body. For example: an alloy of lead and tin is formed of an assemblage of many integrant molecules; but each of these substances would be composed of two others of different kinds, viz: one molecule of lead and one of tin; these last in this case, are called *constituent molecules.* (See *Atoms*, and *Attraction.*)

Molybdates. Combinations of molybdic acid with bases; all the salts resulting from this combination, are decomposable by charcoal, aided by heat; sometimes the molybdic acid is brought to the state of an oxide; sometimes the acid and the oxide are reduced; this is particularly the case with the molybdates of the last four sections.* The neutral molybdates of potash, soda, and ammonia are very soluble; those of lime, strontian, and alumine are scarcely so; those of barytes, and of the last four sections, are always insoluble when the oxide of a molybdate can form a soluble salt with nitric and hydrochloric acids; sulphuric acid decomposes all the molybdates, and precipitates the molybdic acid. Only one molybdate is yet found in nature, viz: that of lead. It is crystallized in tables, is of a very pale yellow, and its specific gravity is 5·486. It is found in Iceland, Siberia, Austria, Sweden, Spain, and Mexico. All the soluble molybdates are prepared directly; all the others are prepared by double decompositions. These salts were discovered by Scheele. In the molybdates the quantity of oxygen of the oxide, is to the oxygen of the acid as 1 to 3.

Molybdate of Ammonia. Uncrystallizable, styptic, of a caustic taste; submitted to the action of fire, it first disengages ammonia; if the heat is increased, the hydrogen of the ammonia is burnt by the oxygen of the molybdic acid, and water and nitrogen are disengaged; the residue is the oxide of molybdenum. This salt is obtained by combining directly molybdic acid with ammonia.

Molybdate of Potash. Crystallizes in rhomboidal shining lamina; it is of a metallic lustre, more soluble with hot than cold water; not decomposable by fire. It is obtained by saturating a solution of potash by molybdic acid, as in the molybdate of ammonia.

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* See Thenard's arrangement of metals, in the article *Metals*.

Molybdate of Soda. Very soluble; not decomposable by fire, styptic, unalterable by the air. It is obtained in a manner similar to the molybdate of potash. and crystallizes more easily.

Molybdenum. (*Molybdène.*) From the Greek *molubdos*, lead.) A metal whose physical properties are not yet well known, on account of the difficulty of fusing it. It has been obtained only in little agglutinated grains. Hielm, who first obtained it, had described it as yellowish on the surface, and greenish in the interior. Clarke, who obtained it in dross, by the aid of his gas blowpipe, states that in this state it is little brilliant; its specific gravity, according to Hielm, is 7·400, and according to Bucholy, 8·611. This metal was long confounded with the per-carburet of iron. Cronstedt first gave it the name of molybdenum; but it was not until 1782, that Hielm obtained the metal. Pelletier and Heyer afterwards studied its properties. This metal resists the most intense heat. It has no action upon oxygen at the ordinary temperature; but at red heat it transforms it into molybdic acid, which sublimes. It has been combined only with chlorine, sulphur, and phosphorus. Molybdenum does not exist pure in a native state; it has yet been found only in the state of a sulphuret of molybdenum, and the molybdate of lead; the former is common in the Alps, the other in Austria. In order to extract the metal, the sulphuret is boiled in nitric acid; to acidify the metal, a paste is formed with molybdic acid, lamp-black, and oil; this is introduced into a crucible lined with charcoal, (*cruset brasqué*) and the operation then proceeds as for the extraction of manganese, raising the heat to its greatest height towards the close of the process.

Mordant. In dyeing, the substance combined with the vegetable or animal fibre, in order to fix the dye-stuff.

Morphia. (*Morphine.*) It is white, bitter, crystallizes in prismatic acicular crystals, with four oblique sides. It is insoluble in cold water, little soluble in boiling water, but soluble in hot alcohol; submitted to the action of fire, it fuses in a radiated mass; heated more strongly it gives azoted products. Concentrated sulphuric acid poured upon morphia, chars it; nitric acid gives it the colour of blood; weak acids combine with it, and form neutral salts. Its existence was suggested by M. Seguin, in 1804, and it was discovered by M. Sertuerner, a pharmacian, in 1808. It has been found only in opium, where it exists combined with meconic acid. M. Sertuerner obtained it by precipitating the aqueous solution of opium by ammonia. M. Robiquet has described a process which is thought preferable; it consists in boiling for a quarter of an hour, a concentrated infusion of opium with a small quantity of pure magnesia, collecting upon a filter, and washing with cold water and weak alcohol the grayish precipitate which is formed; this precipitate being acid, is digested for some minutes with boiling rectified alcohol; the boiling liquor is then filtered. Alcohol, aided by heat, dissolves all the morphia, but does not affect the meconate of magnesia; on cooling, the morphia crystallizes. It is purified by reiterated solutions, and the better if a little animal charcoal is added to the alcohol. Pelletier vainly endeavoured to extract morphia from the poppy* indiginous to France, the solanœ, and some other plants.

This substance in a state of purity has very little action upon the animal economy; this is not the case when this alkali is combined with an acid; it has then all the poisonous qualities of opium. The name of morphia, (from *Morpheus, the god of sleep*) has been given on account of its somniferous properties; it is composed of

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* Opium is extracted from the *Papaver somniferum*; it is exported from Turkey, Egypt, and the East Indies:

Carbon,	72·02
Azote,	5·53
Hydrogen,	7·61
Oxygen,	14·84

Mort aux Mouches. (*Flies' Bane.*) A name given to powdered metallic arsenic, on account of its property when diluted in water, of destroying flies who taste the liquor.

Mort aux Rats. (*Rats' Bane.*) The deutoxide of arsenic.

Mortar. The mortars used in chemistry for pulverizing substances, are of iron, brass, copper, glass, porcelain, marble, stone, &c.

Mucates. Combinations of mucic acid with salifiable bases. All the salts which result, are decomposable by fire and by strong acids. The mucates of ammonia, potash, and soda, are alone soluble. Lime water and barytes decompose them, forming mucates of lime and barytes, which are insoluble. The soluble mucates are obtained directly; the others by double decomposition. According to Berzelius, in the mucates the quantity of the oxygen of the oxide, is to the quantity of the acid as 1 to 13·185.

Mucilage. An aqueous solution of gum.

Muriates. Before the discovery of chlorine, hydrochloric acid, which was thought to be acidified by oxygen, bore the name of *muriatic acid*, and all the compounds which it forms by combining with bases were called *muriates*. (See *Chlorides* and *Hydro-chlorates.*)

Muriates Oxygenated and **Sub-Oxygenated.** See *Chlorates* and *Chlorides.*

Mushrooms. (*Champignons.*) Many chemists have investigated the properties of these vegetable substances. The first experiments were made by Bouillon-Lagrange; his analyses were mostly confined to the *Boletus igniarius* and *laricis*. Braconnot states that the *Boletus juglandis* is in 1260 parts, composed as follows:

Water, - - - - - - - - - - -	1118·30
Fungin, - - - - - - - - - -	95·68
Insoluble animal matter, - - - -	18·00
Animal matter soluble in alcohol, -	12·00
Albumen, - - - - - - - - -	7·20
Fungate of potash, - - - - -	6·00
Adipocere, - - - - - - - - -	1·20
Oily matter, - - - - - - - -	1·12
Sugar, - - - - - - - - - -	0·50

Some traces of phosphate of potash.

Vauquelin states that the *Agaricus campestris* is composed of water, fibrous matter, albumen, sugar, oil, adipocere, a substance which he calls ozmazome, insoluble animalized matter, and acetate of potash.

Mushroom Philosophic. (*Champignon Philosophique.*) A name formerly given to a spongy charcoal obtained as a residue in the burning of certain oils by a mixture of nitric and sulphuric acid.

Myricin. (*Mericine.*) A name given to the substance which remains after treating with alcohol the wax of bees or that of the *myrica* and *ceroxylon*. It is solid, fuses at a temperature between 95° and 100°; its specific gravity is equal to water; it is very little soluble in boiling ether. but dissolves entirely in the volatile oils.

Myrrh. (From a Hebrew word, *Myrrha.*) A gum-resin obtained from a tree which grows on the eastern coast of Arabia Felix. It is of a turbid brick-red colour, solid and heavy, of a peculiar smell and a bitter taste. It is soluble in boiling water.

N.

Naphtha. See *Bitumen.*

Naphthaline. A white substance with the lustre of silver, soft to the touch, and odorous. It fuses at 180°, and crystallizes in cooling. It is prepared by distillation from coal-tar. Naphthaline is heavier than water, dissolves very sparingly in hot water, but is soluble in ether and alcohol. Dr. Thomson terms it a *sesqui-carburet of hydrogen.*

Narcotine. A vegetable substance, white, insipid, inodorous; it crystallizes in rhomboidal prisms, often clustered. By distillation it affords the same products as animal substances; boiling water dissolves of it but $\frac{1}{400}$, cold alcohol $\frac{1}{100}$, and boiling alcohol $\frac{1}{24}$; ether and the volatile oils dissolve it with heat; cold acids dissolve it; the alkalies precipitate it from the acid solutions. It has, from its discoverers, been called *salt of Desrosne,* (*sel de Desrosne.*) It is often called salt of opium. Its action upon the animal economy is not very energetic unless it contains morphine, which is sometimes the case. Narcotine is obtained by treating with ether the opium of commerce until its strength is exhausted. This ether is at first of a yellow colour; it remains for some time turbid, at length deposites a powder which by distillation yields a large quantity of ammonia; when the powder ceases to be deposited, the ether is decanted and evaporated; crystals are formed which are impregnated with a viscous oil containing little masses of caoutchouc, (indian rubber,) which can be mechanically separated. The oily liquid is decanted to separate the crystals, and treated with boiling alcohol; on cooling, the narcotine is deposited in crystals; it is redissolved in the same liquid, again crystallized, and obtained pure.

Natron. (So called from *Natron*, a lake in Judea where it was produced.) A natural carbonate of soda, which is produced abundantly in some lakes by the contact of the chloride of sodium (common salt) with chalk or some variety of carbonate of lime.

Neutral. A saline compound possessing neither the characters of acids nor alkaline salts; such are Epsom salts, nitre, and all the compounds of the alkalies with the acids.

Neutralization. When acid and alkaline matters are combined in such proportion that the compound does not change the colour of violets or litmus, they are said to be neutralized.

Nickel. (*Nikel.*) A white metal, very malleable; its specific gravity is 8·279; it appears to possess magnetical attraction, a property which belongs, with this exception, only to iron and cobalt; nickel when combined with other substances loses this property, while iron loses it but in passing to the third degree of oxidation. It is extremely difficult to fuse, though highly volatile; if heated in contact with the air or oxygen at red heat, it absorbs the latter gas, and changes it to a green oxide. It forms combinations with most of the simple bodies; is dissolved in nitric acid. Its solution gives with the alkalies a green precipitate.

Nickel is found in nature in the state of an oxide, an arseniate, but most abundantly as a sulphuret of nickel united with arsenic, a small quantity of iron, copper, and cobalt; this compound is called by the Germans *kupfednickel;* from this, nickel is usually extracted. The process for obtaining it is complicated: it is necessary at first to wash the ore, in order to expel the arsenic and a small quantity of sulphur; it is then subjected to powerful heat in contact with saltpetre (nitrate of potash); this oxidates the metals, and forms, with the remaining arsenic and sulphur, the arseniate and sulphate of potash; the whole is put into a large quantity of water, in order to carry off the excess of potash and soluble salts; a mixture of the oxide is the residue; this is treated with hydrochloric acid; the excess of acid is driven off by evaporation; the chlorides are dissolved in water, and that of copper is precipitated by a current of sulphuretted hydrogen. The iron and the greater part of the cobalt are precipitated by ammonia; the solutions of nickel and a little of cobalt are treated with potash, which combines with the hydro-chloric acid, and precipitates the two oxides. These are carefully washed, and by the aid of heat treated with a concentrated solution of oxalic acid, which forms two insoluble oxalates; these are washed, and slightly treated with liquid ammonia, which dissolves them. The liquor is exposed to the air, and decanted when nearly free from the ammoniacal odour; the deposite is entirely composed of the double oxalate of nickel and ammonia; this is washed, and on being exposed to an elevated temperature, pure nickel in a metallic state is obtained.

NICOTIN. (*Nicotine.*) A peculiar principle obtained by Vauquelin from tobacco. It is colourless, and has the singular taste and smell of the plant. It dissolves both in water and alcohol; it is volatile and poisonous. To obtain it, evaporate the expressed juice of tobacco to one fourth its bulk; when cold, strain it through fine linen; then evaporate it nearly to dryness; dissolve this again in alcohol, and again reduce it to a dry state. Dissolve the residue in water, saturate the acid which it contains with a weak solution of potash, introduce the whole into a retort, and distil to dryness; redissolve, and again dissolve three or four times successively. The nicotin will thus pass into the receiver dissolved in water, from which solution it may be obtained by very gradual evaporation.

Nihil Album. *White nothing.* A name formerly given to the oxide of zinc. See this word.

Nitrates. (From *nitrum*, nitre.) Salts formed by the union of nitric acid with salifiable bases; as the nitrates of potassa, soda, silver, &c. Exposed to the action of fire, all the nitrates are decomposed, but at different degrees of heat; some give off at once oxide of nitrogen or nitrous acid. When the metal has much affinity for oxygen, and is not at the highest degree of oxidation, it absorbs a portion of this gas, becoming more highly oxidated; thus by heating the proto-nitrate of mercury, the deutoxide is obtained; in other cases, the temperature being high, and the metal having little affinity for oxygen, it is reduced.

Those metals which have the least affinity for oxygen. such as gold, palladium, &c., form nitrates which, exposed to a temperature a little elevated, disengage their acid. As nitric acid cannot exist without water, the nitrates of course contain a small quantitv. The nitrates are decomposed by most of the non-metallic combustible bodies; sulphur in decomposing them often forms a sulphate when the oxide has as much affinity for sulphuric acid as for the alkalies; otherwise it forms a sulphuret; this is most commonly the case. With the nitrates whose metals have not yet been obtained, sulphur can form only sulphurous acid and an oxide. The nitrate of magnesia forms an exception.

When the nitrates are heated with charcoal, a carbonate will be the result; if the oxide has as much affinity for carbonic acid as for potash, soda, &c., the metal will be reduced; if the oxide has little affinity for oxygen, either an oxide and carbonic acid will be obtained or an oxide of carbon, according to the temperature, and quantity of charcoal. Most of the nitrates are soluble in water; such as are not, become so by long contact with this liquid; there are of these two classes; those whose bases are in excess precipitate in the form of a sub-nitrate, the others with an excess of acid dissolve.

A great number of acids, as sulphuric, phosphoric, arsenic, &c., decompose the nitrates; their action is more lively in proportion as the temperature is elevated. The property which sulphuric acid possesses of decomposing the nitrate of potash, (saltpetre,) is the foundation of the art of preparing nitric acid.

When into a solution of a metallic nitrate based neither upon potash, soda, nor lithia, is poured a solution of a sub-carbonate, a sub-phosphate, sulphate, &c., based upon potash or soda, the result is, a decomposition of the two salts, forming a soluble nitrate, and an insoluble sub-carbonate, sub-phosphate, &c. It is only when the nitrate is very acid that decomposition takes place; since, in order that the borate or phosphate, &c. found, should be acid and soluble, the excess of acid must be saturated by potash or soda. (*M. Thénard, Traité de Chimie, tome III.*)

One nitrate exists in nature in large quantities, that of potash or saltpetre; but it is always disseminated, and never found in large masses. The nitrates of magnesia and lime are found in nature; also the nitrate of soda lately discovered in Peru. The nitrates appear to form themselves, when a salifiable base sufficiently energetic is in contact with decomposing animal substances. In this way the nitrates of lime, magnesia, and potash, are formed under our eyes; but we are ignorant of the process which nature carries on in the formation of the great quantities of the nitrate of potash, which cover the surface of the ground in many southern countries. In the neutral nitrates, the quantity of the oxygen of the oxide is to the quantity of the oxygen of the acid in the proportion of 1 to 5; but the sub-nitrates are an exception to this law of composition. The quantity of the base which they contain is extremely variable, sometimes

eight times greater than that of the neutral ni-
l.

TRATE of ALUMINE. (*Nitrate d'Alumine.*) A deli-
ent salt, very styptic, and soluble; it reddens the
ire of litmus, and is decomposed at a low tempera-
Alumine in jelly is precipitated from its solution
e careful addition of an alkali. It is obtained di-
by uniting nitric acid to a jelly of alumine. It is
ut use.

TRATE of AMMONIA. (*Nitrate d'Ammoniaque.*)
allizes ordinarily in six-sided prisms, joined and
ed longitudinally. It is colourless, of a pungent
attracting in a slight degree moisture from the atmo-
e. Cold water dissolves a part of its weight; if
ed to the action of moderate heat, it soon melts in
ater of crystallization; by elevating the tempera-
it is decomposed; this decomposition will be at-
d with an elimination of caloric and light, if the ni-
is thrown upon burning coals; from thence its name
flammable nitre, given by the ancient chemists.
nitrate of ammonia is obtained by uniting directly
nia with nitric acid; the ammonia must be in ex-
because a part volatilizes during evaporation.
salt is formed of 54 of acid, and 17 of the base.

TRATE of BARYTES. (*Nitrate de Baryte.*) A co-
ss salt, of a sharp taste, capable of being crystal-
in octoedrons, which contain no water of crystalli-
, are unalterable by the air, soluble in 20 parts of
at 32°, and in 3 parts at 212°. Barytes forms in-
le salts with many acids; it follows that the solution
e nitrate is precipitated by many of them, but chiefly
e sulphuric and krameric; the latter appears to have
a greater power than the former to separate barytes
its combinations. The nitrate of barytes is obtained
lcining strongly in a crucible a mixture of char-
and native sulphate of barytes. The sulphuret

of barium which is obtained is diluted in 10 parts of water; an excess of nitric acid is added; the liquor is evaporated; by the water of barytes is precipitated a little of iron which it contains; it is filtered and crystals obtained. The nitrate of barytes is often employed as a re-agent. It is composed of 54 of acid and 78 of the base.

Nitrate of Bismuth. (*Nitrate de Bismuth.*) Appears in the form of large colourless crystals; its taste is first astringent, afterwards very caustic. It contains much of the water of crystallization. It is obtained by treating bismuth with nitric acid. Water decomposes this nitrate, giving place to a precipitate of an insoluble sub-nitrate, formerly called *magistery of bismuth*, and to an acid nitrate which remains in solution; this solution precipitates white with ammonia, black with sulphuretted hydrogen, and yellowish or greenish white with the hydro-ferro-cyanate or ferro-cyanide of potassium, orange yellow with the chromate of potash, and white with albumen. The sub-nitrate can be dissolved in nitric acid, and then presents the same characters as the acid solution.

Nitrate of Cadmium. (*Nitrate de Cadmium.*) A colourless salt, which attracts humidity from the air, contains much of the water of crystallization, is very soluble, and susceptible of crystallization in acicular prisms, often in clustered circles. It is obtained by treating cadmium with nitric acid.

Nitrate of Cerium. (*Nitrate de Cerium.*) Cerium can form two nitrates. The proto-nitrate, which is obtained by uniting the protoxide of cerium to nitric acid, is colourless, of a pungent taste, a little sugared, deliquescent, and reddens the tincture of litmus. The deuto-nitrate, which is obtained in heating the deutoxide of cerium with nitric acid, is of a yellowish colour, of a taste similar to the proto-nitrate; it cannot be crystallized unless it contain a great quantity of acid. These substances are without use.

Nitrate of Chrome. (*Nitrate de Chrôme.*) This is little known.

Nitrate of Cinchonine. (*Nitrate de Cinchonine.*) It is obtained by uniting directly cinchonine to nitric acid diluted with water, and slowly evaporating the solution. The nitrate separates in the form of a limpid oil, which collects in little drops; it crystallizes in prisms.

Nitrate of Cobalt. (*Nitrate de Cobalt.*) A violet red salt, susceptible of producing crystals which attract moisture from the air, and are very soluble in water. The cyanide of potassium precipitates this solution a very clear brown; the ferro-cyanide of the same metal precipitates it a clear green; but sulphuretted hydrogen does not precipitate it. This salt is obtained by submitting arsenical cobalt to a number of successive operations. See *Cobalt.*

Nitrate of Copper. (*Nitrate de Cuivre.*) Blue, of a sharp and caustic taste, crystallizes in prisms, often acicular. It is very soluble in water; its solution is decomposed by sulphuric acid; the sulphate, less soluble than the nitrate, easily crystallizes. The solution of the nitrate of copper is precipitated black by sulphuretted hydrogen, blue by ammonia, green by the deutoxide of arsenic, and a chestnut brown by the ferro-cyanide of potassium. The nitrate of copper is obtained by treating this metal with nitric acid.

Nitrate of Gold. (*Nitrate d'Or.*) The deutoxide of gold, can be dissolved only in concentrated nitric acid; the combination is very feeble, and the nitrate is decomposed if submitted to evaporation. Water decomposes it by uniting with its nitric acid.

Nitrate of Glucina. (*Nitrate de Glucine.*) Colourless, deliquescent, uncrystallizable, of a sugared taste; is very soluble in water, and reddens the tincture of litmus. Its solution is not precipitated by sulphuretted hydrogen; with potash and soda it forms a white precipitate which an excess of the alkalies can re-dissolve. It is obtained by treating glucina with nitric acid, and evaporating the solution to dryness.

NITRATE of IRON. (*Nitrate de Fer.*) Of this there are the deuto-nitrate and the trito-nitrate. Nitric acid causes the protoxide of iron to pass to its highest state of oxidation. The *deuto-nitrate* may be crystallized; it is soluble in water; its solution can dissolve a certain quantity of the deutoxide of nitrogen; it is precipitated bluish green by the cyanide of potassium; it is not precipitated by sulphuretted hydrogen. This salt is obtained by introducing iron into diluted nitric acid and concentrating the solution by a gentle heat.

The *trito-nitrate* is always acid, of a beautiful red colour; it is uncrystallizable; it is precipitated white by the ferrocyanide of potassium. In attempting to bring it to the solid state by evaporation, it decomposes and remains in the state of a tritoxide. It is obtained by treating iron minutely subdivided, in nitric acid diluted with its weight of water. There is always a portion of the tritoxide which is not attacked by the acid, and which remains at the bottom of the vessel.

NITRATE of LEAD. (*Nitrate de Plomb.*) White and opaque, of a sugared and astringent taste, soluble in 8 parts of water at 59°. Its evaporated solution produces tetrahedral crystals which contain no water of crystallization. If boiled with thin plates of lead, the latter absorbs a portion of the oxygen of the nitric acid, and the salt is transformed into a sub-hypo-nitrite. The solution of nitrate of lead is precipitated black by sulphuretted hydrogen, white by the ferro-cyanate (*cyano-ferrure*) of potassium. This salt is obtained by diluting litharge (deutoxide of lead) in weak nitric acid. It crystallizes by evaporation.

Nitrate of Lime. (*Nitrate de Chaux.*) Colourless, of a sharp taste, very deliquescent, soluble in water, dissolves also in alcohol, which leaves it to crystallize by evaporation. If into its concentrated aqueous solution a certain quantity of liquid potash is poured, the lime being set free immediately absorbs the water of the solution and forms a solid hydrate. This phenomenon was formerly called *Miraculum Chimicum.* The nitrate of lime is frequently found in nature, but always in small quantities. It is collected with the nitrate of magnesia for the preparation of the nitrate of potash. To obtain the nitrate of lime pure, it must be prepared directly with nitric acid and lime or a very pure carbonate of lime, as white marble.

Nitrate of Lithium. (*Nitrate de Lithium.*) Colourless, very deliquescent, very soluble, crystallizing in rhomboids or in needles; its taste is fresh and sharp; it melts easily and is obtained directly.

Nitrate of Magnesia. (*Nitrate de Magnésie.*) A colourless salt of a bitter taste, deliquescent, very soluble, crystallizing usually in acicular prisms. Potash and soda precipitate magnesia; ammonia precipitates one part only and forms an ammoniaco-magnesian nitrate. It exists with the nitrates of lime and potash in saltpetre beds.

Nitrate of Manganese. (*Nitrate de Manganese.*) The proto-nitrate only is known; it is very soluble and with difficulty crystallized. Its solution is precipitated white by the ferro-cyanate of potassium, and yellow by the simple cyanide. It is obtained by treating the oxides of manganese with nitric acid.

Nitrate of Mercury. (*Nitrate de Mercure.*) Mercury can form two combinations with nitric acid. The *proto-nitrate* is with difficulty obtained, it often contains a small portion of the deuto-nitrate. To obtain it, 18 parts of nitric acid at 77°, 10 parts of water, and 20 parts of mercury are mixed and heated in order to favour their combination. It was formerly prepared by heating mercury with very feeble nitric acid; the result always was a deuto-nitrate, or at least a mixture of the two salts; so that if a solution of chloride of sodium (common salt) was added, no precipitate was formed, the result being a deuto-chloride, which is soluble. This salt is white, very sharp; in contact with the air it decomposes into an insoluble sub-proto-nitrate and a soluble acid proto-nitrate. In order to effect its solution, the water must be slightly acidulated to prevent its decomposition. It may be known when the salt is in the state of a proto-nitrate, by pouring into it a solution of chloride of sodium, which, if this is the case, will form a white precipitate of the proto-chloride. If it is in the state of a deuto-nitrate, the salt will remain in solution. The liquor is filtered and a solution of potash added; if it contains the deutoxide it will be precipitated yellow, otherwise it will be black.

The *deuto-nitrate* is obtained by boiling mercury with an excess of nitric acid, until the solution is not precipitated by a solution of the chloride of sodium. It is then evaporated; a crystallized mass of whitish, sometimes yellowish, needles is obtained. Hot water decomposes this as it does the proto-nitrate, and the insoluble part which is obtained was formerly known by the name of *turbith nitreux*. The solution of the deuto-nitrate is precipitated yellow by potash, white by ammonia and the ferro-cyanate of potassium, and yellow by the cyanide of potassium. It is not precipitated by the chloride of sodium. Sulphuretted hydrogen forms with it an orange and sometimes a black precipitate, which in a short time becomes white. This salt is in pharmacy employed in the preparation of *red precipitate* (deutoxide of mercury) and of some mercurial salts, which are obtained by double decomposition. With the proto-nitrate is prepared the *soluble mercury of Hahnémann*, a medicine which is in high repute in the north of Europe. It is obtained by pouring ammonia into a solution of this salt, a black precipitate is formed, the liquid is filtered, again precipitated by ammonia, again filtered, and this process is continued until no precipitate is formed by ammonia; the ammonia must not be in excess, but the liquor should always contain some of the nitrate in solution.

NITRATE of MORPHINE. (*Nitrate de Morphine.*) It is bitter, is easily dissolved in water, and crystals may be obtained. It is prepared by treating morphine with diluted nitric acid and gently evaporating the solution.

NITRATE of NICKEL. (*Nitrate de Nickel.*) This salt is of a green colour, of a taste at first sugared and afterwards styptic; it dissolves in double its weight of cold water. The solution on being evaporated crystallizes in 8-sided prisms, which retain much of the water of crystallization. Its solution is not precipitated by sulphuretted hydrogen, but it forms an apple-green precipitate with the ferro-cyanate of potassium, and a yellowish white with the simple cyanide of the same metal. (See *Nickel.*)

NITRATE of PALLADIUM. (*Nitrate de Palladium.*) Scarcely known; it is red, soluble, and is precipitated olive green by the ferro-cyanate of potassium.

NITRATE of POTASH. (*Nitrate de Potasse.*) *Saltpetre.* A white salt, of a cool and sharp taste, fuses upon burning coals. It attracts moisture from the air only when the latter is very humid. In commerce it is found in confused crystallized masses. If redissolved and crystallized anew, it is obtained in 6-sided prisms, terminated by dihedral summits; when exposed to the action of heat it fuses; in this state if one sixteenth part of sulphur be added, on cooling, a mass is obtained known by the name of *Mineral crystal.*

The fusion which this nitrate experiences is the igne*ous, for it contains* no water of crystallization. It solves in 4 times its weight of water and in ¼ its weight of boiling water. By calcining the nitrate of potash with the cream of tartar, (supertartrate of potash,) a sub-carbonate of potash is obtained; this however is not perfectly pure, as it contains a little lime; this preparation was formerly called "*Nitre fixé par le tartre.*" By calcining the nitrate of potash with charcoal a sub-carbonate more pure than the preceding is obtained: this was formerly called "*Nitre fixé par le charbon.*"

The nitrate of potash is still used to prepare nitric and sulphuric acids; it forms an important part of gunpowder, and is used in fulminating powder, &c. It is of frequent use in medicine. It is found on the surface of the earth, usually existing with the nitrates of lime and magnesia in places where animal substances have undergone decomposition. It is found in the form of mould, constituting efflorescences of saltpetre upon damp walls, in cellars, and under old buildings. It is obtained pure by lixiviation. The nitrate of potash is formed of 100 of acid, and 87·146 of the base.

Nitrate of Quinine. (*Nitrate de Quinine.*) Exists in rhomboidal prisms with an oblique base; it offers much the same phenomena as the nitrate of cinchonin, but the form of the crystals is very different; those of the nitrate of quinine are rhomboidal prisms with oblique bases.

Nitrate of Rhodium. (*Nitrate de Rhodium.*) It is only known to exist, and to be of a red colour.

Nitrate of Silver. (*Nitrate d'Argent.*) *Lunar Caustic.* Colourless, bitter, very caustic, very soluble in water. It appears not to be deliquescent. Crystals are obtained from it which seem to have no determinate form. It colours the skin black and disorganizes animal substances. It is obtained by dissolving at a mild heat grains of silver with nitric acid. When pure silver cannot be obtained, but alloyed silver as in coin is to be used, the nitrate of silver should be separated as much as possible by crystallization. A blue liquor will at first remain, this will contain some silver; in order to separate it from the copper a solution of chloride of sodium should be introduced, which will form an insoluble chloride with the silver. When it will no longer form a precipitate it must be washed, then calcined with an oily substance and poured into water; the silver will be found very pure. With the nitrate of silver is prepared the *lapis infernalis*, or infernal stone, a name given on account of its strong burning property. The nitrate of silver is formed of 100 of acid and 214.380 of the oxide of silver.

NITRATE of SODA. (*Nitrate de Soude.*) This salt resembles in some of its properties the nitrate of potash; its crystals are rhomboidal prisms, soluble in water. It is obtained by decomposing the sub-carbonate of soda with nitric acid. Great quantities of it are found in Peru. It is composed of 100 of acid and 57·745 of the base.

NITRATE of STRONTIAN. (*Nitrate of Strontiane.*) A colourless salt of a sharp taste; crystallizes in octoedrons, which dissolve by contact with the air. It is prepared like the nitrate of barytes.

NITRATE of TIN. (*Nitrate d'Etain.*) When tin is brought into contact with concentrated nitric acid, the action is very lively, even at the ordinary temperature; the tin passes to the state of a deutoxide by the decomposition of one part of nitric acid, and remains at the bottom of the vessel without combining with the portion of acid not decomposed; but if nitric acid diluted with water be employed, it will only form the protoxide, which will combine with the portion of acid not decomposed, and produce a proto-nitrate. In both cases there is a formation of the nitrate of ammonia, owing to union of the hydrogen of the decomposed water with part of the nitrogen of the nitric acid.

The proto-nitrate of tin is uncrystallizable; its solution is yellowish, and when an attempt is made to obtain it in a very concentrated state it decomposes, giving place to a deposite of the protoxide of tin.

NITRATE of TELLURIUM. (*Nitrate de Tellure.*) Colourless; crystallizes in very elongated prisms, which arrange themselves in groups. Its solution is precipitated orange brown by sulphuretted hydrogen. This nitrate is obtained by treating tellurium with nitric acid.

NITRATE of TITANIUM. (*Nitrate de Titane.*) A white salt, reddens the tincture of litmus, crystallizes in rhomboidal flat prisms. Its solution is precipitated reddish brown by the ferro-cyanate of potassium. This nitrate is prepared by treating with nitric acid the oxide of the metal calcined with potash, and purifying it by washing.

NITRATE of THORINIUM. (*Nitrate de Thorine.*) Very astringent, uncrystallizable; notwithstanding its great solubility, if by careful evaporations its solution can be brought to a sirupous consistence, then exposed to the air and aftewards heated in a sand-bath, it becomes opaque and insoluble. This nitrate is obtained by treating a jelly of thorinium with nitric acid.

NITRATE of URANIUM. (*Nitrate d'Urane.*) Uranium forms two salts with nitric acid; but the proto-nitrate is little known. The *deuto-nitrate* is of a yellowish green, very soluble in water; its solution is precipitated by potash and soda not carbonated. It forms with the ferro-cyanate of potassium a red precipitate, and with the simple cyanide a yellowish white precipitate. If exposed to a certain degree of heat, it changes into a yellow sub-deuto-nitrate, which is entirely decomposed if the temperature continues to be elevated. This nitrate is either obtained by uniting nitric acid directly to the deutoxide of the metal, or by extracting it from phosphated uranium which exists in nature; in the latter case, the mineral is calcined with double its weight of carbonate of soda, the product is submitted to repeated washings; the residue is dissolved in nitric acid and crystallized.

Nitrate of Yttria. (*Nitrate d'Yttria.*) A colourless salt, of a taste at first sugared, afterwards astringent, deliquescent, crystallizing with difficulty; it reddens the tincture of litmus. Its solution is precipitated white by potash and soda. It is prepared by a direct process.

Nitrate of Zinc. (*Nitrate de Zinc.*) Colourless, of an astringent taste, deliquescent, very soluble. Its evaporated solution produces crystals in 4-sided prisms terminated by points with 4 faces. It forms with the ferro-cyanate of potassium, the simple cyanide of this metal; with potash and soda it forms white precipitates; sulphuretted hydrogen also forms with it a similar precipitate. This nitrate is prepared by treating zinc with weak nitric acid.

Nitrate of Zirconium. (*Nitrate de Zircône.*) A white salt, of an astringent taste, uncrystallizable, reddening the tincture of litmus; it gives by evaporation, a transparent viscous mass, little soluble in water. This nitrate is obtained by treating a jelly of the zirconium with nitric acid.

Nitre. (Greek, *Nitron.* Latin, *Nitrum.*) The common name for saltpetre, or the nitrate of potash.

Nitre Ammoniacal. A name formerly given to the nitrate of ammonia.

Nitre Calcareous. (*Nitre Calcaire.*) A name given by ancient chemists to the nitrate of lime.

Nitre Cubic. (*Nitre Cubique.*) An ancient name for the nitrate of lime.

Nitre Inflammable. An ancient name for the nitrate of ammonia.

Nitre Magnesian. Ancient name for the nitrate of magnesia.

Nitrification. The process of the formation of nitrates. This formation takes place only when nitrogen and oxygen in a nascent state are in contact, and when the nitric acid which is the result of the combination of these two gases, meets with a salifiable base which possesses a strong affinity for the acid. Thus in nature we find only alkaline nitrates. It being known that in nature nitrates are never found except in places exposed to animal exhalations, and continued dampness, artificial manufactures of nitre (*nitrières*) have been successfully attempted; in this process it is necessary to use earth, or calcined substances which are not too dense, and which may be easily penetrated by water. Thus marble and other compact calcarious minerals and all quartzose minerals do not promote the formation of nitrates in the most favourable situations. (See *Nitrate of Potash.*)

Nitrites. These are little known; when nitrous acid is brought in contact with a salifiable base, the result is a nitrite and a hypo-nitrite.

Nitrites (Hypo.) They offer characters analogous to those of the nitrates; like them they are decomposed by heat, and dissolved by water except their base is in excess. Many acids decompose them, and the hypo-nitric acid which cannot exist uncombined is transformed into nitric acid and deutoxide of nitrogen. The hypo-nitrite, of lead is obtained by boiling the nitrite of lead with metallic lead; a sub-hypo-nitrite is formed, which is brought to a neutral state, by precipitating a portion of the base by sulphuric acid. With this neutral hypo-nitrite many others can be obtained by double decomposition. According to Berzelius, in the neutral hypo-nitrites the quantity of the oxygen of the oxide is to the quantity of the oxygen of the acid as 1 to 3; but in the sub-hypo-nitrites, the quantities of the base vary as in the sub-nitrates.

Nitrogen. (*Azote.*) (From the Greek *nitron*, which signifies nitre, and *gennao*, to generate, because it is the generator of nitre. The French term, *azote*, signifies a destroyer of life.) A colourless gas, inodorous and insipid; it extinguishes combustion; its specific gravity is 0·9757. It has never been decomposed; it constitutes one of the simple non-metallic bodies. Some chemists have considered it as the oxide of a metal which they have termed *nitricum*; others as one of the oxides of a metal which they call *ammonium*. As neither of these hypotheses has been established by experiments, we must regard nitrogen as a simple substance. It combines with oxygen in 5 proportions, notwithstanding its affinity for this body is but feeble; this combination never takes place by merely bringing the two gases in contact. It has as little affinity for other substances.

The firmest combination of nitrogen is with *hydrogen*, forming *ammonia*. Combined with *carbon*, it forms *cyanogen*. It unites to chlorine, iodine, but with none of the metals except potassium and sodium.

Nitrogen forms $\frac{4}{5}$ of the atmosphere; it is a constituent part of animal substances. It is of little use in an uncombined state. It was formerly called *alcaligène*. It is obtained by burning, under a bell-glass containing atmospheric air, some substances so combustible as to absorb all the oxygen from the air, leaving the nitrogen pure. Phosphorus is often employed for this purpose; nitrogen may also be obtained from liquid ammonia, by decomposing it with liquid chlorine.

Nitrogen Carbonated. See *Cyanogen*.

Nitrogen Oxymuriated. See *Chloride of Nitrogen*.

Nomenclature Chemical. The establishment of the chemical nomenclature as it now exists is one of the greatest services which could have been rendered to the cause of science; where, indeed, we may ask, would now have been the science of chemistry, if arbitrary names only had been given to the numerous compounds which have been and are constantly discovered? What chemists could ever learn this crowd of names, which when recalled bring with them nothing to point out the nature of the bodies composing them? But by the aid of the chemical nomenclature, the name of a salt, an oxide, an acid, or any other compound, gives at once the composition of the substance, and of course suggests most of its important properties. This nomenclature is due to Guyton Morveau.

There exists a certain number of simple bodies (See *Elements*); the names of them are unimportant, provided they are not too long. Different terminations affixed to the names of these elementary bodies, constitute all the nomenclature of chemistry. These simple bodies, oxygen excepted, take also the name of combustible bodies, because that all can form combinations with oxygen, and then take the general name of burnt bodies. We have then two great divisions; *simple combustible* bodies, and *burnt bodies.* The combustible bodies can form among themselves a great number of combinations; these compounds have received different names.

When they are solid or liquid, the name of one of the compounds is terminated in *ure*, and this is followed by the name of the other; as *iodure* of *azote*, *sulphure* of *lead*, *chlorure* of *sodium*, *hydrure* of *sulphur*, &c., to designate the combination of iodine with azote, of sulphur with lead, of chlorine with sodium, and of hydrogen with sulphur.*

Sometimes however, for greater simplicity, the names e simple bodies are given to binary compounds as *d hydrogen* is sometimes called *ammonia; carbonated* , *cyanogen*, &c.; and their combinations with comble bodies are called *ammoniures*, and *cyanures* more monly *ammoniurets* and *cyanides*. Common use has ever more influence than rules of nomenclature; thus mbination takes place between two metals, the comd is called an *alloy*, or *amalgam* if mercury is one of compounds; we would not say an *orure* of *copper*, an *uine* of *mercury*, but an *alloy* of gold and copper, and *malgam* of silver.

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* The translator has here followed the French nomenclature; it is necessary, however, to admonish the English student that our terminations do not correspond with those of the French; their termination in *ure*, is in many cases translated by *ide*, thus *iodure d'azote* is *iodide* of *azote*; *chlorure de sodium*, is *chloride* of *sodium*, &c.; in other cases the termination in *ure* is answerable to *uret*, as *sulfure de plomb* is *sulphuret* of *lead*, &c. The French nomenclature in this, as in many other cases presents a greater simplicity than the English, and is more accordant with scientific principles.

the second class of burnt bodies or such as unite oxygen, the general name of *oxide* is given to the ry compounds which result from the union of simple tances with oxygen, when their compounds do not ent acid properties; and as these combinations can place in different proportions, they are called proto, o, trito, and per oxides, according as the simple subce is oxidated to the first, second, third, or highest ee; thus we say the oxide of carbon, protoxide, oxide, &c., of iron. When oxygen uniting with a tance gives it the peculiar properties described under term acid, the compound takes the general name of , but as one substance may with oxygen form differacids; the termination *ic* (*ique*) is used to denote the est portion of oxygen, that of *ous* (*eux*) the lowest; phosphoric (*phosphorique*) acid and phosphorous *sphoreux*) acid; when a substance forms with oxygen one acid, the termination is in *ic* as carbonic acid. In e cases a simple body may form more than two acids, term *hypo*, signifying *under* is then used; commencing the highest portion of oxygen, we would say:

Phosphoric Acid.
Hypo-Phosphoric "
Phosphorous "
Hypo-Phosphorous "

The acids formed with hydrogen are designated by prefixing the word *hydro*, as hydro-chloric, hydro-sulphuric, (sulphuretted hydrogen,) &c.

The acids can combine with most of the oxides, and form compounds distinguished by the name of salts. A salt formed with an acid ending in *ic* is known by the termination *ate*, if the name of the acid ends in *ous* that of the salt terminates in *ite*. Thus we would say the *sulphate* of *the protoxide* of *lead*; *sulphite* of *the protoxide* of *potassium*. When there is an excess of the base it is called a *sub-salt*; when there is an excess of acid it is called a *super-salt*, or an acid salt; as the *sub-nitrate* of *bismuth*; *the acid* or *super-sulphate* of *alumine*. The termination (more frequent in English) *ine* is used to designate organic salifiable bases, as *Narcotine*, *Quinine*, &c.

NUMBERS PROPORTIONAL. Numbers which indicate the proportion in which substances unite. See *Atom*.

O.

OIL. (*Huile*.) (In Latin *Oleum*, from *olea*, the olive, this name being at first confined to the oil expressed from the olive.) Oil is a substance of a fatty or unctuous nature, either solid or fluid, does not combine with water, burns with flame, and is volatile in different degrees. Oils are never formed but in organic substances; all the minerals which present oily characters have originated from the action of vegetable or animal life. They are distinguished into *fixed* and *volatile* or *essential* oils.

Fixed oils (*huiles grasses*) are usually fluid at the ordinary temperature, are lighter than water, inflammable, more or less soluble in ether and alcohol, and insoluble in water; they combine more or less easily with metallic oxides, forming soaps which are soluble or insoluble according to the nature of the oxides. The fixed oils combine in all proportions with the essential oils. Exposed to the action of the atmosphere, they become thick, and lose their fluidity. Such as dry so hard as not to affect paper when applied to them are called *siccative oils;* linseed oil is of this kind; hence its use in painting. When the fixed oils are submitted to distillation, they furnish much carburetted hydrogen and other products common to fat substances. According to Chevreul, all the fixed oils are composed of elaine and stearine in different proportions.

Oil of Vitriol. (*Huile de Vitriol.*) The common name of sulphuric acid, probably given on account of its oily appearance.

Oils Volatile or Essential. (*Huiles Volatiles ou Essentielles.*) Pungent, caustic, odoriferous; many are without colour, others are yellow, green, or blue; most of them are lighter than water, all are volatile; they easily absorb oxygen, and then become more consistent; some even are solid. Some form a crystalline substance, as the oil of turpentine. These oils do not combine intimately with salifiable bases, the result of the combination being a kind of soap (*savonules*). It is not known whether these oils are formed of two or more immediate principles; according to many analyses, they consist of hydrogen, oxygen, carbon, and nitrogen. Saussure, who studied much into the nature of these substances, found no oxygen in the oils of lemon and turpentine. The essential oils exist in all aromatic vegetables; many are obtained by distillation with water.

Oleates. Combinations of oleic acid with salifiable bases; these salts are decomposable by fire and by most of the acids. Oleic acid unites to bases in different proportions, giving rise to acid, neutral, and sub-oleates. According to the experiments of Chevreul, oleic acid possesses the same capacity of saturation as the margaritic and stearic acids. The oleates of lime, barytes, strontian, magnesia, zinc, &c., are insoluble and pulverulent; they are prepared by double decomposition.

Oleate of Potash. (*Oleate de Potasse.*) Of a bitter taste, alkaline, pulverulent, and colourless. It is very soluble, and attracts humidity from the air; dissolved in two parts of distilled water it forms a jelly, and in four parts, a liquid of sirupous consistence; if dissolved in a great quantity of water, it decomposes into a sub-oleate and potash. Most of the acids decompose it, also the solutions of lime, barytes, strontian, and most of the metallic salts. It is obtained by heating moderately in a capsule one part of potash with one part of oleic acid and four or five parts of water, and suitably evaporating the mixture.

Oleate of Soda. (*Oleate de Soude.*) Is prepared like the preceding; the proportions are 1 part oleic acid, 0·66 of pure soda dissolved in 5 parts of water.

Olivile. A white, pulverulent, inodorous substance, of a bitter and aromatic taste; it is sometimes obtained in little acicular crystals; exposed to a high temperature, it melts and becomes yellow; at a still higher temperature, it decomposes like vegetable substances; it is almost insoluble in cold water, but dissolves in boiling water; the liquid on cooling becomes milky by the precipitation of the olivile; it becomes limpid on boiling anew; if the ebullition is long continued, this substance separates, and appears on the surface in the form of an oily liquid. The olivile exists in the gum of the olive tree; it was first extracted by Pelletier; for this purpose the gum is dissolved in highly rectified alcohol; on standing a short time, the liquor deposites the olivile in the form of little needles; it is redissolved in alcohol, and then washed with a little sulphuric ether, in order to separate the remainder of the colouring matter.

Opium. (From the Arabian *opi*, juice, it being obtained from the juice of the poppy.) A gum-resinous extract from the *Papaver somniferum*, or white poppy. In various parts of Asia fields of poppies are cultivated for this use. Incisions are made into the stems and capsule of the poppy; the juice is collected, and evaporated by gentle heat. Exposed to the action of fire, opium decomposes; when heated in contact with the air, it inflames, and absorbs oxygen. By analysis it has been been found to consist of

Meconic acid, - - - - - - - -	2	parts.
A new acid discovered by Robiquet,	3	"
Morphine, - - - - - - - - -	1	"
Narcotine, - - - - - - - - -	2	"
A substance analogous to caoutchouc,	5	"
Mucilage, - - - - - - - - -	6	"
Fecula, - - - - - - - - - -	7	"
Resin, - - - - - - - - - -	8	"
Fixed oil, - - - - - - - - -	9	"
Vegeto-animal matter, - - - - - -	10	"
Sand and other impurities, - - -	11	"

Orate. A name given by Pelletier to designate a combination of the oxide of gold (*or*) with potash. When a great excess of alkali is added to a solution of the chloride of gold, the liquor immediately becomes discoloured, and takes a yellowish green tint which disappears by adding a little water. A precipitate of the oxide of gold retaining a little of the potash is formed; an acid restores the yellow colour. Pelletier supposes that the hydrated oxide of gold performs the part of an oxide in relation to the potash, and that it forms a very alkaline orate which is soluble in water; that by adding an acid it produces a salt based upon potash, and muriate of gold by the decomposition of the orate of potash. Thenard and some other chemists believe that this salt is but a double salt, because that the muriate of gold uniting to the muriate of potash forms a compound which cannot be precipitated by an alkali.

Ore. (*Mine.*) The mineral substances from which metals are extracted.

Ore of Black Lead. A name sometimes given to the per-carburet of iron.

Ore of Red Lead. (*Minium.*) See *Tritoxide of Lead.*

Orpiment. See *Sulphuret of Arsenic.*

Osmazome. A yellowish brown extract, soluble in water and alcohol, procured from the muscles of animals. It gives a peculiar odour to soap.

Osmium. A solid, pulverulent metal, of a blackish colour. As it has never been fused, its physical properties are not well known. Heated in contact with the air, it absorbs oxygen gas and becomes a white volatile oxide with a most powerful odour. It has been hitherto combined only with chlorine and a few metals. According to Henry, it forms ductile alloys with gold and silver. It is never found but in the ore of platina, combined with iridium. It was discovered by Tennant in 1803.

Oxacids. This word is sometimes used to designate the acids formed of a combustible substance and oxygen.

Oxalates. Combinations of oxalic acid with salifiable bases. They are all decomposable by fire, leaving little residue of charcoal on account of the great quantity of oxygen which the oxalic acid contains. The oxalates present very interesting phenomena. The neutral oxalates of alumine, potash, and soda, are the only ones, having for their bases metallic oxides, which are soluble. Most of the others become soluble by the addition of an excess of acid; the former lose their solubility by the same addition. For this reason, when oxalic acid is poured into a solution of lime or barytes, it forms a precipitate which redissolves by adding an excess of acid; while if to a solution of the oxalate of potash an excess of the same acid be added, crystals of the oxalic acid are formed. Lime, barytes, and strontian are the bases which have the greatest tendency to unite to oxalic acid. In nature but four oxalates are found; those of iron, lime, soda, and potash. All the soluble oxalates are prepared directly by combining oxalic acid with the sub-carbonates. In the neutral oxalates the quantity of the oxygen of the oxide is to the quantity of the acid as 1 to 5·568; in the acidulated oxalates as 1 to 5·568 multiplied by 2; in the acid oxalates as 1 to 5·568 multiplied by 4; and in the sub-oxalates as 1 to 5·568 divided by 2.

Oxalate of Ammonia. (*Oxalate d'Ammoniaque.*) Crystallizes in long prisms terminated by dihedral summits; it has a pungent taste. Submitted to distillation in a retort, it furnishes the sub-carbonate and a portion of the oxalate of ammonia which volatilizes; there is little residuum. Water easily dissolves this salt; it is insoluble in alcohol. Nitric, sulphuric, and muriatic acids abstract a portion of its base, changing it to an acidulated oxalate. It is said that when two solutions of equal parts of corrosive sublimate and the oxalate of ammonia are put in a dark place, the two salts suffer no alterations for many days; but if the mixture is exposed to the rays of the sun, an instantaneous action is observed, the liquor becomes milky, and deposites a certain quantity of the proto-chloride of mercury, disengages carbonic acid, and the liquor becomes clear; it contains only the muriate of ammonia and a little of the oxalate of ammonia. (*Journal of Phar. tome* I. *p.* 62.) The oxalate of ammonia is obtained in laboratories, by saturating a solution of oxalic acid with ammonia and evaporating it. According to Berzelius, it is composed of 100 of acid and 47·679 of the base. It is frequently used as a re-agent to detect the presence of lime. The *acidulated oxalate of ammonia* is much less soluble than the neutral oxalate; it is obtained in the same manner, except that double the acid is employed in its preparation.

Oxalate of Cinchonine. Insoluble and pulverulent; it is obtained by double decomposition.

Oxalate of Potash. (*Oxalate de Potasse.*) Excessively soluble, almost uncrystallizable; when decomposed by fire, the sub-carbonate of potash is obtained for a residue. All the strong acids take from it a portion of its base, and change it to the state of an acid oxalate, which is precipitated if the solution is concentrated. It precipitates with all the acids which can form insoluble oxalates. It is obtained by saturating the salt of wood sorrel (*Oxalis acetocella*) with potash. The *acidulated oxalate of potash* crystallizes in short opaque parallelopipeds; it reddens blue vegetable colours, is less soluble than the preceding; it does not attract moisture from the air. It is obtained very pure, by adding to a solution of potash twice the quantity of oxalic acid which is necessary for its saturation.

Oxalate (Acid) of Potash. *Sub-oxalate of potash. Salt of sorrel.* This is less soluble than the neutral and acid oxalate; it crystallizes easily. It contains twice as much of the acid as the acidulated oxalate, and four times as much of the neutral oxalate. By some chemists it is called *quadroxalate of potash.* In Switzerland it is extracted from the common sorrel (*Rumex acetocella.*) The salt of sorrel is used for removing ink spots and iron rust from linen.

Oxalate of Soda. (*Oxalate de Soude.*) Exists in small granular crystals having little taste: when decomposed by fire, it offers similar products to the preceding; it is obtained by the combination of soda with the juice of *Oxalis acetosella, rumex,* &c. The *acidulated oxalate of soda* is much less soluble, and reddens the tincture of litmus.

Oxides Metallic. (*Oxides Metalliques.*) Compounds which result from the combination of oxygen with metals. The ancient chemists called them metallic lime, supposing them to be metals deprived of an imaginary substance which they called *phlogiston.* The most important difference between the metallic and other oxides, is the property they possess of combining with acids, neutralizing them, and forming salts. All the oxides are brittle, solid, inodorous, (except that of osmium,) and insipid, except those of the second class* (as osmium and arsenic.) All the oxides are heavier than water, and less so than most of the metals. None redden the tincture of litmus, but many restore its colour when reddened with an acid. The oxides heated in close vessels, present different phenomena; a few are deprived of all their oxygen; others lose but a part; many retain it with great tenacity. *Light* has not a very perceptible effect upon them; though some chemists have asserted that it reduces the oxide of gold. *Chlorine* decomposes many oxides, disengaging oxygen, uniting to their metals, and thus transforming them to chlorides: this however does not take place but at an elevated temperature. Liquid chlorine does not combine with the oxides; it decomposes them in part, unites with the decomposed portion to form a chloride, while the oxygen of the metal combines with a part of the chloride, producing chloric acid which unites to the portion of the metal not deoxidized. This experiment succeeds well with potash. *Iodine* at a high temperature produces upon some metallic oxides effects similar to those of chlorine; that is, by forming an iodide and disengaging oxygen. Through the medium of water, it decomposes many oxides, forming iodides (*iodures*,) and iodates. *Nitrogen* has no action upon the oxides at any temperature. *Sulphur*, at an elevated temperature, decomposes all the oxides of the last five sections; with all the oxides of the last four sections, it disengages sulphuric acid, and the deoxidated metal unites to the sulphur; with the oxides of the second section, there is a formation of a sulphate and a sulphuret (*sulfure*). Sulphur through some medium presents nearly similar effects; yet according to Thenard, water is decomposed with the alkaline oxides in such a manner as to produce hypo-sulphurous acid and sulphuretted hydrogen, which uniting with a portion of the base, form a hypo-sulphite and a hydro-sulphuret. *Phosphorus* has no action upon the earthy oxides; it decomposes the oxides of the second section, forming phosphates and phosphurets, (*phosphures*,) with the oxides of the last four sections, it gives different products. When the oxide may be easily reduced, the result is a phosphuret and phosphoric acid; when this is not the case, there is a formation of a phosphuret and phosphate; it would even be possible, if the metal was highly oxidated and had a great affinity for oxygen, that only a phosphate would be obtained. Phosphorus united to water exhibits different phenomena; it acts only upon the alkaline oxides and those which are easily reduced. In the first case a phosphate is formed, and phosphuretted hydrogen disengaged, a hydro-phosphite is also produced, which proves that the water is decomposed; in the second case the oxide is reduced, and phosphoric acid formed. *Carbon*, at a temperature more or less elevated, reduces all the oxides except those of the first and second section; it disengages either carbonic acid or the oxide of carbon. *Electricity* reduces all the oxides except those of the first section. *Selenium*, according to Berzelius, produces with the oxides effects similar to those of sulphur. The *hydracids* in uniting to the oxides decompose them; the oxygen of the oxide combines with the hydrogen of the acid, forming water, while the reduced metal unites to the disengaged base of the hydracid.

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* See Metals, Thenard's sections.

Oxide of Aluminum. (*Oxide d'Aluminium.*) White, smooth to the touch, insoluble in water, and forming a paste with it, infusible by the fire of a forge furnace, without action upon oxygen or atmospheric air; its specific gravity, according to Kirwan, is 2·000; it is seldom found pure in nature; it exists in the sapphire, and is frequently combined with silex. It was discovered in 1754, by Margraff. Many chemists have since studied its nature; they have until recently considered it as a simple earth, which they designated by the name of *alumine.* Since the discovery of the alkaline metals, chemists have been forced by analogy to add this substance to the list of metallic oxides. Alumine is obtained from alum; for this purpose, alum is dissolved in about 20 parts its weight of water; ammonia is added until a precipitate is no longer formed. The alumine in precipitating, takes always with it so much water as to give it the appearance of a jelly; after being well washed, it is dried by heat. Gay-Lussac has described another process for obtaining it; this is convenient and economical when the object is not to obtain the alumine in a jelly. By this process, it is only necessary to apply to the alum, for half an hour, a heat sufficiently great to redden the crucible; all the ammonia, and all the sulphuric acid will escape, leaving only the alumine in a very white powder.

OXIDE of ANTIMONY (DEUTO.) (*Deutoxide d'Antimoine.*) White, reducible by the voltaic pile, insoluble in water, without action upon air or oxygen gas, and undecomposable by fire. It is obtained by pouring diluted nitric acid upon powdered antimony, slightly heating the liquor, and then adding stronger acid. The metal oxidizes without dissolving, becoming a yellow white, then white by calcination. Berzelius states that this oxide reddens litmus, and partly saturates salifiable bases; for these reasons he called it antimonious acid. According to Thenard, it is composed of 26·07 of oxygen, and 100 of the metal.

OXIDE of ANTIMONY (PROTO.) (*Protoxide d'Antimoine.*) It is obtained by dissolving in water the protochloride of antimony; a white powder called *powder of algaroth,* is immediately precipitated; this is a subchloride of antimony. This precipitate is heated with a solution of potash, which unites with the chlorine, and sets free the oxide; it must be filtered and washed with many waters, in order to be obtained pure. Another method of obtaining the protoxide of antimony, is to heat antimony to redness in a long earthen crucible; a thick, white smoke is disengaged, which being condensed, forms a white crystalline substance, formerly called *argentine flowers of antimony*. This, in its composition, is the same as the preceding protoxide. According to Thenard, both contain 18·5 of oxygen to 100 of the metal.

OXIDE of ANTIMONY (TRITO.) (*Tritoxide d'Antimoine.*) At a high temperature it disengages a portion of its oxygen and becomes a deutoxide; it is obtained by exposing to a red heat for a considerable time, a mixture of 1 part of powdered antimony to 2 of the peroxide of mercury. This oxide is formed in preparing that ancient composition, formerly known under the name of *diaphoretic antimony*. For this purpose a mixture of equal parts of antimony and nitrate of potash are thrown into a crucible and heated to redness; a mass composed of the peroxide of antimony and potash is obtained. In this experiment, the oxygen of the nitric acid, goes to the antimony, and the potash unites in part to the oxide formed. By treating this mass with water, the greatest part of the potash with a little of the antimony, dissolves; the residue constitutes the diaphoretic antimony which is a compound of 20 parts of potash and 80 of the tritoxide of antimony.* According to Berzelius, the tritoxide or peroxide of antimony is composed of 30·993 of oxygen to 100 of the metal; the chemist calls it *antimoniac acid* on account of its property of uniting to bases; he admits also a fourth oxide of antimony, which he names sub-oxide; this, according to him, is formed by exposing antimony to a current of humid air, or to the positive pole of the voltaic pile.

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* Berzelius remarks that this oxide thus obtained, can exist only in the state of a hydrate, and that it would lose part of its oxygen by dessication.

Oxide of Arsenic (Deuto.) (*Deutoxide d'Arsenic.*) This oxide, known by the name of *white arsenic*, *rat's-bane*, and *arsenious acid*, is white, of a sharp and nauseous taste; when taken internally it disorganizes and ulcerates the parts in contact. It is one of the most deleterious poisons, occasioning death when taken in a very small dose. The deutoxide of arsenic is volatile, a property which it possesses in common with the oxide of osmium; when it vaporizes, it may be distinguished by an odour resembling that of garlic; it is soluble in boiling water, does not redden blue vegetable colours; on the contrary it greens the tincture of violets. It is undecomposable by fire, is without action upon atmospheric air and oxygen gas; when heated with sulphur it yields all its oxygen, burning one part of the sulphur, and forming with the other part a red sulphuret of arsenic. It is found in nature either in crystals or a pulverulent form; but that which is used in commerce is obtained from the wasting of the ore of arsenical cobalt. Thenard considers this oxide as formed of 100 of metal and 32·28 of oxygen. The deutoxide of arsenic is employed in painting, in the manufacture of *Scheele's green*, &c.: it is also of use in medicine; but on account of its poisonous properties, it should be used with great care. Arsenic may be known by being thrown on burning coals, where it gives off vapours which smell strongly of garlic; its aqueous solution is precipitated white by lime water; sulphuretted hydrogen gives it a yellow colour and precipitates by the aid of heat the yellow sulphuret of arsenic; this test is so faithful, that according to Orfila, it would detect the one hundred thousandth part of white arsenic dissolved in a liquid. The solutions of sulphuret of potassium and sulphuret of sodium, also precipitate arsenic in yellow flakes; but it is necessar to add some drops of strong acid, that they may unite with the base of the sulphurets, otherwise there will be no precipitates. Legal writers upon medicine, have, by omitting this circumstance, led to many errors in attempts to detect the presence of arsenic.

Oxide of Arsenic (Proto.) (*Protoxide d'Arsenic.*) Black and pulverulent. If heated in close vessels, this oxide decomposes to a deutoxide and a metallic arsenic, for this reason some chemists regard it only as a mixture of metallic arsenic and the deutoxide of arsenic. Berzelius thinks it to be a peculiar acid; he obtained it by exposing powdered arsenic for a long time to the air; it appears to consist of 8 of oxygen to 100 of the metal.

Oxide of Azote (Deuto.) *Deutoxide of Nitrogen. Nitrous gas,* or *nitric oxide.* A colourless gas, without action upon vegetable colours; its specific gravity is 1·0390; it extinguishes combustion, absorbs oxygen with extreme avidity, deeply reddens litmus, and passes to the state of nitrous acid. Heat and electricity decompose this oxide; no combustible body has action upon it at the ordinary temperature, but at a red heat many combustibles take its oxygen and set the azote free. Phosphorus transforms it into phosphoric acid and phosphuretted azote. Chlorine has no action upon it when the gases are very dry, otherwise nitrous and muriatic acids will be formed. Iodine and azote do not combine with it. Burning sulphur plunged in this gas is immediately extinguished. Cold water dissolves one twentieth part of its volume; boiling water does not dissolve an atom. It is always a product of art; in order to prepare it, pour into a flask containing copper filings, some nitric acid, and fit to the flask a bent tube with one end placed in the cistern in a manner suitable for obtaining the gas. The nitric acid decomposes in part, to oxidate the metal, while the portion not decomposed dissolves the oxide formed; the deutoxide of azote set free, disengages in the state of gas which passes into the receiver. The first portions of the gas should be suffered to escape on account of the atmospheric air contained in the retort. In weight, it consists of 100 of azote, 112·98 of oxygen. It was discovered by Hales.

Oxide of Azote (Proto.) *Protoxide of Nitrogen. Nitrous oxide.* A colourless gas, inodorous, of a sugared taste, specific gravity 1·5273. This gas is not permanent. Faraday succeeded in liquefying it with a very heavy pressure. Caloric and the electric fluid decompose it into azote and the deutoxide of azote. One of its essential properties is that of rekindling combustion like oxygen gas; this is owing to the great facility with which combustible bodies decompose it. This gas has been called *oxidated azote, dephlogisticated nitrous gas.* The English chemists some years since announced that it possessed the singular property of exciting in all persons the most pleasurable and delightful sensations. Vauquelin, Gay-Lussac, and Thenard repeated the experiment, but instead of finding it uniformly exhilarating, they discovered that by inhaling it, serious accidents, such as vertigoes, syncopes, &c. were caused.* The protoxide of azote does not exist in nature, it is easily procured by decomposing at a mild heat, the nitrate of ammonia; the salt is decomposed, part of the oxygen of the acid unites to the hydrogen of the ammonia, forming water; the nitric acid being thus by the loss of oxygen reduced to nitrous gas, (*deutoxide of azote,*) it unites to the azote of the ammonia, and forms the protoxide of azote. This gas was discovered by Priestly in 1772; and since then its properties have been investigated by Davy, Vauquelin, Gay-Lussac, Thenard, and Faraday.

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* The French chemists could not have read with attention the account given by Sir H. Davy, of the various effects of this gas, as he expressly states, that in some cases they were disagreeable and painful.

Oxide of Barium (Deuto.) (*Deutoxide de Barium.*) Of a greenish gray colour, alkaline, having little taste. Exposed to the air, it disengages oxygen and attracts carbonic acid; submitted to a high heat it loses a portion of oxygen, and is brought to the state of a protoxide. All simple non-metallic bodies transform it at a high temperature to the protoxide of barium. Liquid chlorine decomposes it cold, disengaging oxygen and producing the chloride of barium; heated strongly with hydrogen gas it disengages light and heat, producing, by the formation of water, a hydrate of the protoxide. Cold water has little action upon the deutoxide of barium; boiling water disengages a part of its oxygen. It does not exist in nature; it is prepared by heating the protoxide with hydrogen; the operation should be performed over mercury. It may be obtained from the hydrate by pouring a concentrated solution of barytes into acid oxygenated water. It deposits brilliant spangles, but these cannot be dried without disengaging oxygen gas. Thenard, who has paid much attention to the properties of this oxide, states that it contains double the quantity of oxygen to that contained by the protoxide.

Oxide of Barium (Proto.) (*Protoxide de Barium.*) *Barytes.* It is of a grayish white, caustic, and strongly greens the infusion of violets. Exposed to the air, it attracts moisture and carbonic acid. When heated with oxygen gas, it absorbs it and transforms itself into a deutoxide; if submitted to the action of fire in contact with the air, it is converted into a deutoxide and protocarbonate; by a degree of heat more elevated, it decomposes, and only the proto-carbonate of barytes is obtained. Barytes is not found in nature except in combination with carbonic and sulphuric acids. The knowledge of this substance is due to a triple discovery of Scheele; this pharmacian discovered in one experiment, muriatic acid, (chlorine,) manganese, and barytes; Faraday and Vauquelin first obtained barium in a state of purity; it was regarded as a simple body until Davy made the discovery of the alkaline metals. The protoxide of barium is composed of 11·669 of oxygen and 100 of barium. It is employed only in the laboratories of chemists.

OXIDE of BISMUTH. (*Oxide de Bismuth.*) Is yellowish, without action upon air and oxygen gas; it fuses when submitted to red heat. Some mineralogists think that it exists on the surface of native bismuth. It is easily procured by boiling with a solution of potash or soda, the sub-nitrate of bismuth; in order to obtain it pure the precipitate should be washed, filtered, and calcined. It may also be prepared by heating bismuth in contact with the air. It consists of 100 of metal, and 11·275 of oxygen.

OXIDE of CADMIUM. (*Oxide de Cadmium.*) According to Stromeyer, the oxide of cadmium; is sometimes yellow, sometimes brownish, and even black. In the state of a hydrate it is always colourless, it is undecomposable at the highest heat, is easily reducible by charcoal. It exists in nature, combined with carbonic acid and silex, in zinc ores. This oxide is obtained by heating the metal in contact with the air; by potash is precipitated a soluble salt of cadmium.. It is composed of 100 parts of metal, and 14·352 of oxygen.

OXIDE of CALCIUM (PROTO.) (*Protoxide de Calcium.*) *Lime.* (*Chaux.*) It is a white substance, of a caustic taste, greens the infusion of violets; its specific gravity is 2·3, it is commonly called *quick lime.* Submitted to the greatest heat, it undergoes no alteration; exposed to the air it attracts humidity and carbonic acid, is reduced to powder and passes to the state of a sub-carbonate; by the aid of heat it combines with phosphorus and iodine. Sulphur, selenium, and chlorine effect its decomposition. Lime dissolves in 700 times its weight of water; it absorbs this fluid with great avidity, forming with it a true hydrate, and presenting many remarkable phenomena: when upon a piece of lime some drops of water are poured, the water is rapidly absorbed without the lime appearing to be moistened; it soon with a hissing noise exfoliates, the vapour of the water passes off, and the lime crumbles to powder; it eliminates so much caloric as to set fire to tinder; this process is called slaking lime; one part of the water passes to a solid state, leaves its caloric, and reduces to vapour the part of the water which is still liquid. This production of vapour is sometimes accompanied with light. Lime has been known from the highest antiquity; it is extensively diffused in nature, but never found in a state of purity, being combined with carbonic, sulphuric, and phosphoric acids; with the first it constitutes marble, chalk, building stones, &c.; with the second it forms plaster or gypsum; and with the third exists in the bones of all animals. The carbonate is usually employed for obtaining lime; the carbonic acid is driven off by heat, and lime in a tolerably pure state is obtained. The calcining of limestone for commerce is carried on in a large way in lime-kilns in countries which furnish an abundance of carbonate of lime. For use in the laboratory, lime is obtained by introducing powdered marble or oyster shells (which are a very pure carbonate of lime) into a porcelain or earthen retort, and subjecting it to heat; the carbonic acid passes off, and lime remains in the retort. Too great a degree of heat should be avoided, otherwise the carbonate of lime which contains silex would undergo a kind of vitrification which would change its properties; it is then said to be burnt. The lime is known to be sufficiently calcined when it no longer effervesces with acids. The protoxide of calcium is composed of 100 of a metal, (called *calcium*,) and 39·068 of oxygen. It was regarded as a simple body until the discovery of potassium. Lime is of great utility; it is employed in the manufacture of soap, for the construction of buildings, for the preparation of ammonia, and for manuring land; it is an important reagent in the laboratory of chemists; it is also used by the physician in some medicinal preparations.

Oxide of Carbon. (*Oxide de Carbone.*) An inodorous, invisible, insipid gas, extinguishing combustion; when inhaled by the lungs it is fatal to animal life. Its specific gravity is 0·9727. This gas supports the intensity of the heat and the action of the voltaic pile without being decomposed; it has no action upon atmospheric air and oxygen gas. Among combustible bodies, chlorine alone acts upon it; when a very dry mixture of equal parts of chlorine and the oxide gas of carbon are exposed in a flask to the influence of the solar rays, the volume contracts half its bulk, giving rise to an acid known by the name of *chloroxi-carbonic gas*, (also called *chloro-carbonous acid*, or *carbo-muriatic acid, phosgene gas*, &c.) The oxide gas of carbon is inflammable; if brought into contact with a lighted taper, it burns with flame and is changed into carbonic acid; it is almost insoluble in water. This gas is procured by introducing at a high temperature carbonic acid into a porcelain tube filled with dry charcoal; it may also be procured by decomposing by heat in a retort the oxalate of lead or zinc; in both these cases it is necessary to pass the gaseous product across a solution of wax or potash in order to absorb the carbonic acid which it always contains. It is formed of one volume of carbon and 1½ volume of oxygen, or in weight of 100 of oxygen and 76·56 of carbon. It was discovered nearly at the same time by Mr Cruikshank in England, and by MM. Clement and Desormes in France.

Oxide Caseous. (*Oxide Caseux.*) A name given by M. Proust to a white, insipid, inodorous, and spongy substance, which is obtained from caseum or fermented gluten; this oxide exists abundantly in old cheese; it is obtained from its combination by successively using rectified alcohol, diluted alcohol, and water.

Oxide of Cerium.* (*Oxide de Cerium.*) White, almost infusible; submitted to the action of fire, at a high temperature, it passes to the state of a deutoxide. It has not yet been found in nature; it is procured easily by decomposing the chloride of cerium by a solution of soda, or potash; the precipitate is washed and filtered. It is composed of 100 of cerium, and 17·41 of oxygen. *The deutoxide* is of a chestnut brown; it is without action upon atmospheric air and oxygen gas. It exists in some copper mines of Sweden, constituting what some mineralogists called *cerite*. It may be obtained by suitably heating the protoxide, or decomposing the deuto-nitrate by dissolving it in nitro-muriatic acid. The filtered solution being neutralized with pure potassa, it is precipitated by tartrate of potassa. Hisinger, Berzelius, Vauquelin, and Laugier have all investigated the properties of these oxides. The last of these chemists has published an excellent process for separating them entirely from the oxide of iron.

Oxide of Chlorine. (*Oxide de Chlore.*) A yellowish green gas, of an odour not disagreeable, and having no analogy to that of chlorine. It does not redden litmus, but destroys its colour. According to Faraday it may be liquefied. Exposed to a high temperature it becomes luminous, exploding with such violence as to break the vessel which contains it; phosphorus introduced into this gas produces similar effects. Water dissolves it readily, and acquires a corrosive and disagreeable taste. This oxide was discovered by Davy in 1815, and has since been investigated by Count Stadion. Its preparation is attended with danger on account of its liability to

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[*] The planet Ceres was discovered about the same time as this oxide, hence the name.

explosion. Thenard advises, in order to prevent such accidents, to prepare it as follows: let a paste, made of the pulverized chlorate of potash and of diluted sulphuric acid, be introduced into a glass tube hermetically sealed at one end; place it vertically and fit to it a little bent tube, heat it very slowly in a sand-bath; the disengaging gas must be collected over mercury; it is a mixture of one twentieth of oxygen and one fortieth of chlorine. The oxide of chlorine is in volume composed of 1 of oxygen and 1½ of chlorine condensed into one. Chevreul called it the chloride of oxygen, (*chlorure d'oxigène.*) By treating the chlorate of potash with hydrochloric acid, an oxide of chlorine has been obtained, which has been called *euchlorine* and *chlorous acid;* but according to Davy and Thenard it appears to be but a simple mixture of the preceding oxide gas with a certain quantity of chlorine.

OXIDE of CHROME (DEUTO.) (*Deutoxide de Chrôme.*) This oxide is brown, pulverulent, brilliant, insoluble in water and in acids. It is obtained by dissolving in nitric acid the protoxide to the state of a hydrate, and evaporating the solution until it no longer disengages nitrous vapours. According to Berzelius it is formed of 100 of metal and 56·84 of oxygen.

OXIDE of CHROME (PROTO.) (*Protoxide de Chrôme.*) Green, pulverulent, infusible and undecomposable by the heat of the furnace, without action upon oxygen gas at any temperature, insoluble in water. Thenard and Gay-Lussac obtained, by heating the oxide of chrome with part of its weight of potassium or sodium, a brown mass which on being cooled burnt spontaneously in the air, transforming itself into a chromate of potash or soda. This oxide is sometimes found on the surface of chromated lead; it is this which causes the green colour of the emerald and many magnesian rocks. In order to prepare it, a very common method is to decompose the chromate of mercury at a high temperature; the mercury is disengaged and the oxide of chrome remains fixed. The oxide of chrome was discovered by Vauquelin. It is composed of 100 of chrome and 42·633 of oxygen. This oxide is employed in the arts; it is this which gives the fine green colour to porcelain, and which colours the artificial stones made to imitate the emerald. It is used in chemistry in order to extract the metal.

Oxide of Cobalt (Deuto.) (*Deutoxide de Cobalt.*) Black, insoluble in water and the acids. Exposed to a high temperature it abandons a portion of its oxygen. It *is found* in nature on the surface of arsenical cobalt. It is obtained by decomposing the nitrate of cobalt with heat, or by exposing the protoxide to a red heat. According to Proust, it is formed of 100 of metal and 26 of oxygen, and according to Berzelius, of 40·647 of oxygen.

Oxide of Cobalt (Proto.) (*Protoxide de Cobalt.*) Gray, almost infusible, blue when in the state of a hydrate. It absorbs oxygen easily, becoming a peroxide. It exists in nature only in combination. It is procured by decomposing the chloride of cobalt by a solution of potash or soda; it combines with acids and forms rose-coloured solutions. According to Berzelius, it contains 100 of metal to 27·097 of oxygen. The oxides of cobalt are employed in giving a blue colour to glass and enamel; it is the base of Thenard's blue (cobalt blue).

Oxide of Columbium. See *Columbic Acid.*

Oxide of Copper (Proto.) (*Protoxide de Cuivre.*) An orange red, fusible into a reddish mass, changes to a deutoxide at a heat little elevated. It exists in nature, is frequently found either in crystals or in capillary veins in deposites of sulphuretted copper. It is obtained by decomposing the chloride of copper by potash or soda. It is formed of 100 of metal and 12·636 of oxygen.

Oxide of Copper (Trito.) (*Tritoxide de Cuivre.*) Thenard obtained this oxide by means of oxygenated water and the nitrate of copper. See his Treatise on Chemistry.

Oxide Cystic. (*Oxide Cystique.*) It is found in some animal substances; it may be found described in the Chemical Treatise of Dr. Wollaston, and has also been noticed by Lassaigne.

Oxide of Glucinum, or Glucina. (*Oxide de Glucinium, ou Glucine.*) (The name is derived from the Greek *glukus*, sweet, because it gives that taste to the salts which it forms.) White, insipid, without action upon simple bodies. Exposed to a strong heat, it melts to a white enamel. It is insoluble in water, attracts carbonic acid from the air, and possesses the property of forming sugared salts if they are soluble. This substance has yet been found only in the emerald, the beryl, (*aigue-marine*) and the euclase. Glucina is extracted from the emerald by treating the mineral successively with potash and hydro-chloric acid, evaporating the residue to dryness, diluting it with water and then filtering it; into the filtered liquor is poured an excess of the sub-carbonate of ammonia, it is filtered a second time and then boiled; the carbonate of glucina which was rendered soluble by the excess of the sub-carbonate of ammonia is deposited; it is washed and strongly calcined in order to disengage the carbonic acid. Glucina was discovered by Vauquelin, and regarded as a simple substance, until the discovery of the alkaline metals.

Oxide of Gold (Deuto.) (*Oxide d'Or deuto.*) It is reddish yellow when in the state of a hydrate, and brown when it is dry. It may easily be reduced by heat and by the voltaic pile; it has no action upon oxygen, dissolves with difficulty even in the strongest acids; on the contrary it dissolves very well in alkalies, and according to Pelletier acts with them the part of an acid. That chemist gives the following process for obtaining it: a solution of the chloride of gold is boiled with magnesia;

the oxide precipitates and takes with it a portion of the magnesia; the precipitate is boiled with diluted nitric acid which dissolves the magnesia without attacking the oxide of gold, which remains in the state of a hydrate; it is collected on a filter and dried under the receiver of the pneumatic cistern. It is by Berzelius said to consist of 100 of gold and 12·077 of oxygen.

Oxide of Gold (Proto.) (*Protoxide d'Or.*) Berzelius admits an oxide of gold which according to him contains but one third of the oxygen of the deutoxide of gold; but if this oxide exists, it is decomposed with the greatest facility by light. It remains in combination with hydro-chloric acid when the hydro-chlorate of gold (muriate) is evaporated until chlorine can no longer be disengaged.

Oxide of Hydrogen (Deuto.) See *Oxygenated Water.*

Oxide of Hydrogen (Proto.) (*Prctoxide d'Hydrogène.*) The scientific name of water; it is not however in use; the common name being consecrated by the highest antiquity, it would appear ridiculous to attempt to substitute its chemical name.

Oxide of Iridium. (*Oxide d'Iridium.*) This oxide is not known, because that iridium cannot be acted upon by acids and oxygen gas. It can be oxidated only by calcining it strongly with the nitrate of potash; but it is impossible to separate it wholly from the alkali. The salts of iridium being sometimes red and sometimes blue, Vauquelin supposes that there may be many oxides of this metal.

Oxide of Iron (Deuto.) (*Deutoxide de Fer.*) Black and magnetic; if heated in close vessels, it fuses without being decomposed; but in the air, unless the temperature be too elevated, it passes to the state of a tritoxide. Gay-Lussac, in investigating the properties of this substance, observed the following remarkable phenomenon, viz. that this oxide, when heated to redness in a porcelain tube with hydrogen gas, formed water, and the metal was reduced. This circumstance is the more surprising as fire decomposes water at the same temperature. According to Vauquelin, concentrated nitric acid carries it to the highest point of oxidation, dissolving it, and producing a colourless trito-nitrate. Sulphuric acid dissolves without changing it, and forms a deuto-sulphate which varies in colour with the quantity of oxide dissolved. This oxide is soluble in a great excess of ammonia. The deutoxide of iron is found abundantly in nature. It is sometimes crystallized in octoedrons or dodecahedrons; as that found in Sweden and the island of Corsica. It exists also in the form of sand in France, Italy, &c., or in compact masses, as in Bohemia, Siberia, Norway, and many other places.

The deutoxide of iron constitutes the loadstone, or magnet (*aimant*); it is obtained by exposing iron filings in a porcelain tube to a current of steam as long as any hydrogen comes over. It is employed in medicine under the name of *ethiops martial*; this may be obtained by making with pure water a paste of iron filings, putting the paste into a shallow earthen pan, and often stirring it, taking care to have the surface kept moist. The mass heats, disengages from the water hydrogen gas; the iron uniting to the oxygen of the water becomes a deutoxide. A more expeditious method is to add about one eighth part nitric acid to the water used in making the paste; this causes a more sudden increase of temperature, and the operation is completed in a few hours. By washing the deutoxide with several waters, the ethiops is obtained perfectly pure. According to Gay-Lussac, it is formed of 100 of iron and 38 of oxygen. Dulong and Berzelius think that it is but a combination of the protoxide with the tritoxide, and that the one performs the part of an acid with respect to the other.

Oxide of **Iron** (**Proto.**) (*Protoxide de Fer.*) This oxide is known only in the state of a hydrate; it is then white. It cannot be dried without passing to a higher state of oxidation; it becomes greenish on being brought in contact with the air, then takes a reddish tinge by absorbing oxygen and carbonic acid. It is insoluble in water, and exists in nature only in combination with silex and sulphuric acid. The protoxide of iron is obtained by decomposing a solution of the sulphate of iron with potash or soda; the precipitate is washed with water which has been deprived of air; it is then preserved in flasks of water closely stopped. According to Gay-Lussac, it is composed of 100 of iron and 28·3 of oxygen. It was discovered by Thenard and Chenevix.

Oxide of **Iron** (**Trito.**) (*Tritoxide de Fer.*) Violet red, more fusible than iron, not decomposable by heat, not magnetic, insoluble in water. It absorbs carbonic acid from the air at the ordinary temperature. The tritoxide of iron exists in nature in great quantities; as in the *hematites*, *oligiste iron*, *eagle-stone or ætite*,* *brown oxide of iron*, &c., which are almost entirely constituted of this substance. It is found in various countries; as Norway, Sweden, Siberia, the island of Elba, various parts of North America, &c. It is the tritoxide of iron which colours the different kinds of clays known under the names of *red ochre*, *yellow ochre*, *clay of Tripoli*, *bole of Armenia*, *terra sigillata*, &c. This oxide was formerly known in medicine under the name of *colcothar*; it may be obtained, 1st, by decomposing the nitrate of iron with heat; 2d, by precipitating a trito salt of iron by potash or soda; 3d, by decomposing the sulphate of iron at a high heat, in order to disengage the sulphuric acid.

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* This is found in nodules of various sizes, from that of a small nut to the size of a man's head The ancients supposed that the eagles were in the habit of transporting these balls to their nests; they therefore gave them the name of *eagle-stones*. The mineralogical name in English is *Nodular Argillaceous Oxide of Iron*.

Oxide of Lead (Proto.) (*Protoxide de Plomb.*) *Litharge.* Yellow; it easily fuses, crystallizes in yellow scales on cooling; it has no action upon oxygen gas at the ordinary temperature; but it attracts a little carbonic acid from the air; at a heat little elevated it passes to a higher degree of oxidation. It exists in nature only in combination with acids. It is prepared in laboratories by heating to redness the red oxide of lead, (*minium,*) or by decomposing the proto-nitrate of lead in a platina crucible. This acid is an article of considerable importance in commerce; it is obtained in the working of argentiferous (silver-bearing) lead ores. The alloy of lead and silver is calcined in the open air; the silver remains pure, and all the lead oxidates. The protoxide of lead is stated by Berzelius to consist of 100 of metal and 7·73 of oxygen. It is much employed in the arts; it is used in preparing *white lead, Naples yellow,* the *acetate of lead,* &c., and also for medicinal preparations.

Oxide of Lead (Per.) (*Oxide Puce. Per-oxide. de Plomb.*) Brown, insoluble in acids, passes to the state of a protoxide at a red heat. It inflames when triturated with sulphur, forming a sulphuret of lead and disengaging sulphurous acid. It has no action upon the air or oxygen gas. It is not found in nature, but is obtained by bringing the red oxide of lead in contact with concentrated nitric acid. One portion of the oxygen of the oxide of lead unites with another part of the same oxide forming the protoxide; this protoxide is dissolved in the nitric acid; the precipitate is washed and carefully preserved from contact with the air. It is said to consist of 100 of metal and 15·474 of oxygen. It is not used in the arts or in medicine.

Oxide of Lead (Sub.) (*Oxide de Plomb sous.*) Ash coloured. It is said by Berzelius to be formed by exposing lead at a small increase of temperature to the air.

This oxide, according to Dulong, may be obtained by calcining the oxalate of lead.

Oxide of Lead (**Deuto.**) (*Deutoxide de Plomb.*) A lively red; it is unalterable by the air, is insoluble in acids. In contact with nitric acid one portion deoxidates and becomes soluble, while the other gains oxygen and precipitates in the form of an insoluble peroxide. At a red heat this oxide decomposes into oxygen and a yellow protoxide. Some mineralogists believe that it exists in nature with sulphuretted lead. It is prepared in the arts by calcining lead in large reverberatory furnaces; the lead fuses and is covered with a crust of yellow oxide of lead, known by the name of *massicot;* this crust is removed as well as others which are formed. When all the lead is changed to *massicot*, the calcination is still continued for a time, in order to oxidate the lead which might still be in a metallic state; the oxide is then withdrawn from the furnace and cooled by throwing upon it cold water. This oxide is known in commerce as *minium*, or *red lead*, (*mine de plomb rouge*). It sometimes contains the oxide of copper and the protoxide of lead; these may be separated by leaving the oxide for some days in water a little acidified by vinegar; the two oxides dissolve, while the deutoxide of lead remains without being affected. The deutoxide of lead is formed of 100 of metal and 11·587 of oxygen. It is used in potteries for glazing, it is also employed in the manufacture of crystal and in oil painting. It may be but a combination of the protoxide and the tritoxide.

Oxide of Lithium. (*Oxide de Lithium, ou Lithine.*) *Lithia.* (From the Greek *lithos*, a stone.) White, very caustic, inodorous, greens the infusion of violets; and strongly attracts carbonic acid from the air, changing itself to a sub-carbonate; it is soluble in 100 times its weight of water. This substance is analogous to potash and soda; it is much more soluble in water than barytes or strontian. Combined with acids it forms neutral salts. Its tendency to attack platina is such, that according to Berzelius, this metal can always be depended upon to detect traces of lithia in any mineral. This savant directs to take a piece of mineral of the size of a pin's head, by means of a blow-pipe to heat it with an excess of soda upon a thin leaf of platina; the mineral is decomposed, the soda expels the oxide of lithium from its combination, and the excess of soda, being liquid at this temperature, spreads over the leaf of platina surrounding the decomposed mass. Around this melted alkaline mass the platina takes a deeper colour, forming a circle, darker and larger in proportion as the mineral takes a greater portion of lithia. The platina resumes its metallic lustre on being washed and heated; oxidation does not take place without the alkali.

Lithia has hitherto been found only in the *petalite*, *triphane*, green *tourmaline*, and the *rubellite;* it exists in these but in very small quantities. The oxide of lithium, or lithia, may be obtained by strongly calcining, in a platina crucible, for two hours, a mixture of equal parts of carbonate of barytes and of a mineral containing lithia; the carbonate of barytes is decomposed, while the barytes uniting to the mineral changes its nature, rendering it liable to be acted upon by acids. By the aid of heat the mass is dissolved in diluted hydro-chloric acid, the hydrochlorates which are formed are then dried; the residue is diluted with water and filtered in order to separate the silex. The solution contains only the hydro-chlorates of alumina, barytes, iron, and lithia; by sulphuric acid all the barytes is separated, ammonia is added to saturate the excess of acid. When the liquor is neutral, an excess of the carbonate of ammonia is introduced; this decomposes all the salts except the lithia, precipitating them in the state of a carbonate. The sulphuric acid decomposing the hydro-chlorates; there remains in the liquor only the sulphate of lithia, ammonia, and the hydrochlorate of ammonia; the residue is strongly calcined in order to decompose the ammoniacal salts, and the pure sulphate of lithia alone remains. This sulphate is redissolved in distilled water, and the sulphuric acid being saturated by a solution of barytes, precipitates an insoluble sulphate of barytes, and the new alkali remains in solution in the liquor; this is evaporated in a retort to dryness, in order to prevent the lithia from absorbing carbonic acid from the air. The oxide of lithium is supposed to be formed of 100 of metal and 78·25 of oxygen. This new alkali was discovered in 1818 by M. Arfwedson.

Oxide of Magnesium. (*Oxide de Magnèsium.*) *Magnesia.* A white, soft powder, without odour or taste; it greens the sirup of violets; its specific gravity, according to Kirwan, is 2·3. It has no action upon oxygen gas and imponderable fluids; it is infusible by the most violent heat, and at the ordinary temperature, attracts the carbonic acid from the air. Among combustible bodies, chlorine alone is known to have any action upon this earth.

Magnesia exists abundantly in nature, but always in combination with acids or metallic oxides. It is obtained by heating the sub-carbonate of magnesia, until it will no longer effervesce with acids. It is employed in medicine under the name of *calcined magnesia, magnésie calcinée.*) The oxide of magnesium consists of 100 of metal (*magnesium,*) and 63·159 of oxygen. It was discovered by Frederic Hoffman, in 1722; but Dr. Black first considered it as a peculiar substance; it was afterwards studied by Margraff and Bergmann, and regarded as a simple body until the discovery of potassium, by Davy.

Oxide of Manganese (Deuto.) (*Deutoxide de manganèse.*) A substance of a reddish brown colour, reducible by the voltaic pile, insoluble by water, and not decomposable by fire. This oxide absorbs the oxygen of the atmosphere, at the ordinary temperature, particularly if the air is humid. In contact with nitric acid, it separates into a soluble protoxide, and a peroxide which is precipitated. It exists in nature only in combination with silex. It is obtained by strongly calcining the peroxide. According to Arfwedson, it consists of 100 of metal, and 37·475 of oxygen.

OXIDE of MANGANESE (PROTO.) (*Protoxide de manganése.*) White in the state of a hydrate; green when it is dry; it readily attracts the oxygen of the air, and becomes brown: it is reducible by the voltaic pile, and undecomposable by fire. According to Clarke, it has been reduced by losing its oxygen, by means of Brooke's blow-pipe. It is obtained by precipitating a proto-salt of manganese with potash or soda. It is preserved like the protoxide of iron. It is composed of 100 of metal, and 28·1077 of oxygen.

OXIDE of MANGANESE (TRITO or PER.) Blackish brown, of a metallic appearance when in crystals, without action upon oxygen gas, reducible by the voltaic pile, insoluble in water. Heated strongly in a porcelain tube with phosphorus, it changes into a phosphate of manganese; sulphur in the same situation changes it to a sulphuret, disengaging sulphurous acid. The peroxide of manganese exists in nature in great quantities; sometimes in brilliant needles, as in sulphuretted antimony; sometimes in stalactites, but oftener in masses which have a metallic appearance, sometimes varying from brown to black. It is only pure when crystallized; considerable deposites of it are found both in primitive and secondary countries; it exists in the Vosges mountains, the Cevennes, and the Hartz, in Saxony, Siberia, and various parts of North America. It can be prepared in laboratories by decomposing with heat the nitrate of manganese. It is composed of 100 of manganese, and

56·215 of oxygen. It is employed in the arts for the preparation of chlorine, and in the laboratories of chemists, for the obtaining of oxygen gas. Arfwedson admits *four oxides* of manganese; he designates by the name of *tritoxide*, one which is intermediate, between the deutoxide and the oxide above described; he considers it as composed of 100 of metal, and 42·016 of oxygen; but this oxide is not by most chemists supposed to have an existence.

OXIDE of MERCURY (DEUTO.) (*Deutoxide de Mercure.*) *Red Precipitate.* Of a lively red, yellow when in the state of a hydrate. This oxide is reducible at a red heat; it has no action upon atmospheric air and oxygen gas. At a temperature little elevated, it yields its oxygen to most combustible bodies. It is always a product of art. It is obtained by dissolving mercury in nitric acid, and afterward decomposing the mercurial salt by heat; the nitric acid is decomposed into oxygen and nitrous acid which is disengaged. The deutoxide of mercury remains in the form of violet red spangles, which on cooling become orange red. The operation is completed when nitrous vapours, which can always be known by their odour, are no longer visible. This deutoxide can also be obtained by decomposing the per-chloride of mercury by a solution of soda or potash, and washing and drying the precipitate; or by heating mercury in a matrass for fifteen or twenty hours, at a temperature near to boiling and in contact with the air. The oxide thus obtained, was formerly called *precipité per se*. The deutoxide, or red oxide of mercury, on which alcohol has been burnt, was called *arcanum corallinum*. This oxide is formed of 100 of mercury, and 7·9 of oxygen. It is only used in medicine, and the laboratories of chemists.

OXIDE of MERCURY (PROTO.) (*Protoxide de Mercure.*) This oxide exists only in combination. Many chemists have considered the black precipitate which is obtained by decomposing the proto-nitrate of mercury by a solution of soda or potash, as a protoxide of mercury. According to M. Guibourt, it was not proper to take for a protoxide, the black precipitate obtained by decomposing the proto-nitrate of mercury by a solution of soda or potash; he thinks this pretended protoxide is but a mixture of deutoxide and subdivided mercury; for by rubbing it between two hard bodies, little globules of metallic mercury appear.

OXIDE of MOLYBDENUM (DEUTO.) (*Deutoxide de Molybdène.*) *Blue oxide.* As this oxide possesses all the properties of acids, in a certain degree, it has been described under the article *Acid Molybdous.* Richter called it *blue carmine.* It was used in painting before the discovery of Thenard's blue. (*Cobalt blue.*)

OXIDE of MOLYBDENUM (PROTO.) (*Protoxide de Molybdène.*) Of a reddish brown and crystalline appearance. It does not exist in nature. It was obtained by Bucholz, by heating strongly, in a crucible covered with powdered charcoal, pulverized molybdate of ammonia. It contains 100 of metal and 16·755 of oxygen.

OXIDE of NICKEL (DEUTO.) (*Deutoxide de Nickel.*) This oxide was obtained by Thenard when treating nickel with oxygenated water and potash. This chemist not having analyzed the oxide, considered its existence somewhat doubtful. See Thenard's Treatise on Chemistry.

OXIDE of NICKEL (PROTO.) Of a deep brown when dry, and of an apple-green when in the state of a hydrate. The protoxide of nickel is almost infusible; it is reducible by hydrogen gas aided by heat; it has no action upon atmospheric air and oxygen gas. It is easily obtained by decomposing a proto-salt of nickel by potash or soda; it precipitates in greenish flakes. According to Berzelius, it is composed of 100 of metal and 27·049 of oxygen; but Lassaigne states the quantity of oxygen to be only 20.

Oxide Nitrous. (*Oxide Nitreux.*) See *Deutoxide of Azote.*

Oxide of Osmium. (*Oxide d'Osmium.*) White, of an odour similar to that of horse-radish; caustic, melts and volatilizes easily, is reducible by heat; it has no action upon oxygen gas, combines difficultly with acids; it dissolves well with alkalies, exhibiting in combination with them phenomena analogous to those presented by the oxide of gold. It does not exist in nature; it is obtained by heating a mixture of osmium and the nitrate of potash in a retort, to the neck of which is fixed a small receiver, into which the oxide of osmium in the form of an oily liquid passes; this on cooling becomes solid. It is not used in medicine or the arts.

Oxide of Palladium. (*Oxide de Palladium.*) Reddish brown when in the state of a hydrate, black when it is dry. It is always a product of art. It is obtained by pouring into a solution of the chloride of palladium an excess of potash, heating, washing, and drying the precipitate. It was discovered by Vauquelin; according to Berzelius, it consists of 100 of metal and 14·207 of oxygen.

Oxides of Phosphorus. (*Oxides de Phosphore.*) Some chemists admit two oxides of phosphorus; the first, which they call *white oxide*, (*oxide blanc*,) is formed whenever phosphorus remains some time in water in contact with the air. The cylinders of phosphorus become covered with a whitish crust, of an odour similar to phosphorus, but less inflammable. The other oxide, which chemists call *red oxide*, (*oxide rouge*,) is the residue obtained on distilling phosphorus which has been several times used for the analysis of atmospheric air. Phosphorus burnt rapidly in the air produces a similar substance. This appears to differ little from the preceding except in colour. Thenard considers these two oxides identical, except that the first is in the hydrated state.

Oxide of Platina (Deuto.) (*Deutoxide de Platine.*) Black, insipid, reducible by the pile and by heat, decomposable by most of the combustible bodies. This oxide is obtained by pouring an excess of caustic soda into a solution of the chloride of platina; it is made to boil, one part of the oxide precipitates, and the other by means of the alkali remains dissolved in the liquor, till after many washings it is obtained pure. According to Berzelius, it is composed of 100 of platina and 16.45 of oxygen.

Oxide of Platina (Proto.) (*Protoxide de Platine.*) It resembles the protoxide of gold. According to Berzelius, it remains in combination with hydro-chloric acid when the hydro-chlorate of platina is evaporated, until it no longer engages chlorine. Chenevix also admits this oxide.

Oxide of Pluranium. It appears in long prismatic rose-coloured crystals, and is obtained from the native platina of Russia. After this platina has been subjected to the process for obtaining osmium, if the residue is allowed to rest for 24 hours, these crystals appear.

Oxide of Potassium (Deuto.) (*Deutoxide de Potassium.*) Yellowish green, very caustic. It strongly greens the sirup of violets. All simple bodies except nitrogen take from it a portion of its oxygen, reducing it to a protoxide. Water decomposes it. It does not exist in nature; it is obtained by heating under a bell-glass a small piece of potassium with an excess of oxygen gas; the operation must be performed over mercury. This oxide consists of 100 of potassium and 60 of oxygen. It was discovered by Gay-Lussac and Thenard.

Oxide of Potassium (Proto.) (*Potasse.*) *Potash.* So called from the pots or vessels in which it was first made. When pure it is white, caustic, very alkaline; of a specific gravity greater than the metal, reducible by the voltaic pile, particularly when aided by mercury; fusible at red heat. Exposed to a high temperature with oxygen gas, it combines with it and becomes a deutoxide. It is not acted upon by boron, nitrogen, hydrogen, or carbon. Phosphorus, sulphur, selenium, chlorine, and iodine act upon the protoxide of potassium, (see *Oxides Metallic*). Exposed to contact with the air, it attracts humidity and carbonic acid, and the result is a liquid sub-proto-carbonate. At a high temperature one part attracts the oxygen of the air, and the other carbonic acid, from which there is a formation of the deutoxide and proto-carbonate; but in continuing to heat it for some time the mass is converted into the proto-carbonate of potash. It is obtained in laboratories by exposing potassium in thin plates to very dry oxygen gas. Care must be used not to employ atmospheric air which contains carbonic acid, and which is more or less charged with water, for it has such an affinity for water, that at its highest temperature it retains a quarter of its weight of water. In this state it is known by the name of the *hydrate of the protoxide of potassium*, or *potash*.

Potash was formerly called *kali* and vegetable alkali, on account of its being obtained in a pure state by the lixiviation of vegetables. Weeds are found to afford more ashes and more salt than wood. The weeds or wood should be burned within doors on a grate, and the ashes laid in a chest as fast as they are produced. The ashes should be lixiviated with twelve times their weight of boiling water. The ley thus formed should be evaporated to dryness in iron pans or pots. The salt thus produced is of a dark colour and contains much extractive matter, and being formed in iron pots, is called potass or potassa: The extractive matter of this pure potash is burnt off in a reverberatory furnace. Much care should be taken to prevent the potash from melting, as the extractive matter would not then be perfectly consumed, and the alkali would form such a union with the earthy parts as could not easily be dissolved. When the salt is thus refined it is called *pearlash.*

Potash for use in the arts is often obtained by throwing into an iron basin heated to redness, a mixture of the nitrate of potash, (saltpetre,) and pulverized cream of tartar. The mixture takes fire, much azote is thrown off; water and carbonic acid are formed from the elements of the two acids; all the products volatalize except the carbonic acid, which combines with the potash, forming a sub-carbonate. This is dissolved in three times its weight of water; an equal part of quick lime diluted in 12 times its weight of water is added; it is then boiled, water being added in proportion to the evaporation which takes place. The carbonic acid of the potash unites to the lime, forming an insoluble sub-carbonate of lime, and the potash deprived of carbonic acid remains in solution in the liquid. It is boiled until the liquid no longer precipitates lime water; the solution is then filtered; the residuum remaining upon the filter is washed with boiling water until the waters of the washings are nearly tasteless; all these waters are united and evaporated to dryness; the mass which results from the evaporation is then fused by heat, poured upon marble, and when partly cooled it is put up in flasks, which are hermetically sealed.

The potash most commonly used in commerce is composed of the sub-carbonate, the muriate, and sulphate of potash, silex, lime, the oxides of iron and manganese. Potash in ancient medical books was called *potential cautery.* The protoxide of potassium consists of 100 of metal and 20 of oxygen. The hydrate of the protoxide, according to Thenard, consists of 25 parts of water to 100 of the protoxide. Potash is employed in the making of glass; it is the basis of all the common soft soaps; it enters into the composition of saltpetre, alum, &c.; it is the basis of many salts used in medicine and in the arts;

combined with water in the state of a hydrate, it is of frequent use in medicine. It exists in nature only in combination with acids.

Oxide of Rhodium (Deuto.) (*Deutoxide de Rhodium.*) Brown, combines with difficulty even with the strongest acids. It acts with the alkalies in a manner analogous to the deutoxide of gold. It can be obtained by strongly calcining pulverized rhodium with caustic potash, and the nitrate of potash; the mass is lixiviated and brought in contact with sulphuric acid in order to attract the alkali which it contained. According to Berzelius, it consists of 100 of rhodium and 13·32 of oxygen.

Oxide of Rhodium (Proto.) Black, pulverulent; mixed with a deoxygenating body it explodes, and is reduced. It is obtained by heating rhodium in contact with the air. Berzelius states that it consists of 100 of metal and 6·66 of oxygen.

Oxide of Rhodium (Trito or Per.) Solid, red, pulverulent; at a feeble heat it loses part of its oxygen and becomes a black protoxide. It is procured by decomposing a solution of the chloride of rhodium by potash or soda. According to Berzelius, it contains three times as much oxygen as the protoxide. None of the oxides of rhodium are of use.

Oxide of Selenium. (*Oxide de Sélénium.*) Discovered by Berzelius; it has never been obtained in a state of purity, no method having yet been discovered for separating it from the air with which it is mixed. It appears to be gaseous, colourless, without action upon vegetable colours. Its odour resembles that of cabbage in a decaying state; water dissolves but a small quantity, but sufficient to imbibe its odour. It is obtained by burning selenium under a small bell-glass filled with air or hydrogen gas.

Oxide of Silicium. (*Oxide de Silicium, ou Silice.*) (From a Hebrew word *Selag.*) *Silex.* White, inodorous, insipid, rough to the touch, infusible with the most intense heat, without action upon imponderable fluids, oxygen, atmospheric air, and all combustible non-metallic bodies. Silex is extensively diffused in nature, sometimes in a state of purity, sometimes in combination with alumine, iron, manganese, soda, potash, &c. It is very pure in the hyaline quartz, crystallized in beautiful six-sided prisms terminated by pyramids with six faces; sand and the white free stone are almost wholly composed of it; it constitutes the greater part of agate, cornelian, opal, mill stones, &c. It is found in solution in water, in most vegetables, &c.

Pure silex is obtained in laboratories as follows: powdered flint or quartz is mixed with 2 parts of potash and heated in a crucible to a red heat; the mass swells and at length fuses; the matter is then poured into a capsule and boiled with 3 times its weight of water; the liquor is filtered and a little strong acid poured upon it; much carbonic acid is disengaged, a salt based upon potash is formed, and the silex is precipitated in the form of a gelatinous hydrate; the liquor is decanted, the precipitate washed with many waters, collected upon a filter, and dried; it is then calcined to redness and preserved for use. If the silicated potash should be dissolved in too great a quantity of water, it would not form a precipitate by the addition of an acid; it would then be necessary to evaporate the liquor in order to increase the cohesion of the silex.

This substance has been known from the earliest antiquity; ancient chemists called it *vitrifiable earth*, because it entered into the composition of glass. It was afterwards called silex; after the discovery of potassium, it was by analogy ranked among the metallic oxides; but Berzelius has recently insulated silicium, and from this learned chemist it appears that it should no longer retain a place among the metallic oxides, (see *Silicium.*) Silex is very useful in the arts; it is the base of all glass and earthen ware, even of porcelain; it is employed in reducing some ores to a metallic state, as those of copper, iron, &c.

Oxide of Silver. (*Oxide d'Argent.*) Pulverulent, of an olive green colour; insipid, without action upon air or oxygen; alterable by light, reducible by a feeble degree of heat. It is a product of art; it is obtained by precipitating a solution of the nitrate of silver, by potash or soda; the precipitate is filtered, and washed many times in order to obtain the oxide of silver perfectly pure. It is said that silver which has been kept in the air for some time in a state of fusion, absorbs oxygen; this oxide is however but transient, it reduces as soon as the temperature is lowered. The oxide of silver is in laboratories employed to obtain very pure oxygen: According to Gay-Lussac and Thenard, it consists of 100 of metal and 7·8 of oxygen.

Oxide of Sodium (Deuto.) (*Deutoxide de Sodium.*) It contains more oxygen than the deutoxide of potassium; it is at first deliquescent, becomes efflorescent, on exposure to the air; it loses part of its oxygen at a high temperature; for this reason, in order to obtain it, sodium is first burnt in oxygen, and afterwards treated with this gas; as the combustion alone produces only the protoxide.

Oxide of Sodium (Proto.) (*Oxide de Soude*) *Soda.* Solid, white, very caustic; it strongly greens the infusion of violets; acts with combustibles in a manner analogous to the protoxide of potassium; like that, it is deliquescent by attracting the carbonic acid of the air, and becoming efflorescent. It exists in nature only in the state of combination with acids, and some metallic oxides. It is obtained by burning the metal in oxygen gas. The protoxide of sodium like that of potassium, has such an affinity for water, that it always retains a certain quantity even at the highest temperature, and it is in the state of a hydrate of the protoxide of sodium that this substance is employed. It is obtained by treating the sub-carbonate of soda, successively by lime and alcohol. It is not easily decomposed by fire. Soda has important uses in the arts; combined with silex, it forms glass; united to oil and grease, it forms hard soap; with chlorine it forms common salt; and with the acids a series of salts of grêat importance in medicine and in the arts. According to Gay-Lussac and Thenard, the protoxide of sodium consists of 100 of metal and 33·995 of oxygen. Berzelius states the proportion of oxygen at 34·372.

Oxide of Strontian (Deuto.) (*Deutoxide de Strontium.*) This oxide is known only in the state of a hydrate. In this state, it is in thin pearly scales, little soluble in water. It partly decomposes by drying; it is alkaline, greens the infusion of violets, reddens curcuma paper. It is obtained by pouring a solution of strontian into oxygenated water; as it is soluble it is deposited with facility. It is washed by decantation and preserved for use.

Oxide of Strontian (Proto.) *Strontian.* It is of a whitish gray, of a bitter taste, caustic, strongly greens the infusion of violets, reddens curcuma paper. Exposed to the air, it attracts carbonic acid, and passes to the state of a sub-carbonate of strontian. Boiling water dissolves it; on cooling, it deposites lamellar crystals. Strontian exists in nature only in the state of combination with carbonic and sulphuric acids, more commonly with the latter. This substance is obtained by decomposing the nitrate of strontian at a red heat. The protoxide of strontian is composed of 100 of metal and 18·273 of oxygen. It was discovered by Klaproth, but it is to Pelletier and Vauquelin that we are chiefly indebted for a knowledge of its properties; it was considered as an elementary body until the discovery of the alkaline metals. It is only used in chemistry.

Oxide of Tantalum. (*Oxide de Tantale.*) See *Oxide of Columbium.*

Oxide of Tellurium. (*Oxide de Tellure.*) White, fuses below red heat; oxygen and atmospheric air do not act upon it. Strong acids easily dissolve it; with the alkalies it in a degree performs the part of an acid, and gives products which are little soluble. It does not exist in nature; it is procured by decomposing the nitrate of tellurium by heat. According to Berzelius, it consists of 100 of tellurium and 24·797 of oxygen. It was discovered by Klaproth.

Oxide of Thorinum. (*Oxide de Thorinum, ou Thorine.*) *Thorina.* White, without odour or taste, infusible, not reducible by the voltaic pile, or by any known means, insoluble in water. Exposed to the air it attracts carbonic acid, and gives it off at red heat. It dissolves in nitric, sulphuric, and hydro-chloric acids, producing salts which have an astringent taste. The following process for obtaining thorina is given from Berzelius: the pulverized *gadolinite* of Korarfvet is dissolved in hydro-nitrochloric acid (nitro-muriatic); this forms the hydro-chlorates of yttria, of cerium and thorina; from these the iron is separated by the acidulated succinate of ammonia. After having saturated the excess of acid of the solution by caustic ammonia, it is filtered in order to separate the succinate of iron; sulphate of potash is poured into the liquor, which precipitates the cerium; the liquor is again filtered, and an excess of ammonia added; the yttria and thorina are precipitated; the precipitate is washed with many waters, and redissolved in hydro-chloric acid; the hydro-chlorates are evaporated to dryness, and boiled with water, which dissolves that of yttria, and decomposes and precipitates that of thorina. By washing and drying the precipitate, the thorina is obtained pure. This substance is very rare. Berzelius could only obtain it from the deuto-fluates of cerium and yttria, and in the gadolinite of Korarfvet.

OXIDE of TIN (DEUTO.) (*Deutoxide d'Etain.*) White, undecomposable by fire, unalterable by the air. This oxide dissolves in potash, on account of which property Berzelius gave it the name of stannic (*stannique*) acid. It exists abundantly in nature in Cornwall, England; in Saxony, Bohemia, Spain, &c. It also forms rich mines in China, Malacca, and Mexico. This natural oxide is sometimes crystallized in quadrangular prisms; it is always coloured by a little oxide of iron. The deutoxide of tin is obtained in laboratories by treating small bits of tin with nitric acid. It may also be procured by calcining tin in contact with the air; the deutoxide of tin is not employed in the arts.

OXIDE of TIN (PROTO) (*Protoxide d'Etain.*) Blackish gray, reducible by the voltaic pile, insoluble in water and undecomposable by fire. This oxide heated in contact with the air, easily inflames and passes to the state of a deutoxide. It is obtained by decomposing a solution of the proto-chloride of tin by ammonia. It is at first precipitated in the state of a white hydrate; but it blackens if dried with a gentle heat. According to Gay-Lussac and Berzelius, it consists of 100 of tin and 13·6 of oxygen. The deutoxide, according to the same chemists, is formed of 100 of tin, and 27·2 of oxygen.

OXIDE of TITANIUM.V· (*Oxide de Titane.*) White, almost infusible, dissolves in acids after its cohesion is destroyed. It is found in nature, but always in primitive countries. It constitutes the *anatase* of Saint Gothard, &c.; combined with lime and silex it forms the mineral called *sphène:* the oxide of titanium is generally found with the oxide of iron, silex, &c. M. Laugier has given a process for obtaining this oxide; it consists in calcining at a high temperature the natural oxide with the subcarbonate of potash; lixiviating the mass, dissolving the residue in hydro-chloric acid by the aid of a gentle heat; pouring into the liquor oxalic acid; washing the precipitate, drying, and calcining it in order to expel the little hydro-chloric acid which it might have retained, and to decompose the oxalic acid; the oxide of titanium will remain pure.

OXIDE of TUNGSTEN. (*Oxide de Tungstène.*) Dark brown. This oxide is very little known; it is unalterable by the air, and insoluble in water, it does not exist in nature. It is procured by passing at red heat a current of hydrogen gas through a porcelain tube. It has been observed that if the temperature is greatly elevated, a blue oxide has been obtained which seems to be distinct from the brown oxide. The oxide of tungsten is formed of 100 of metal and 16·564 of oxygen.

OXIDE of URANIUM (PROTO.) *Oxide d'Urane.* Blackish gray, almost infusible, without action upon atmospheric air and oxygen gas, at any temperature. It is obtained by strongly heating the metal in contact with the air. It is found in nature in Saxony, Bohemia, &c.* According to Berzelius, it is composed of 100 of uranium, and 6·360 of oxygen. It was discovered by Klaproth, and studied by Bucholz, who admitted six oxides of the metal.

OXIDE of ZINC (DEUTO.) *Deutoxide de Zinc.*) Discovered by Thenard; it was obtained by means of oxygenated water, by a process similar to that used in the preparation of the tritoxide of copper. It is white, insipid, and inodorous; it decomposes spontaneously; thus it has but an ephemeral existence. It dissolves in acids, losing part of its oxygen.

OXIDE of ZINC (PROTO.) (*Protoxide de Zinc.*) White, insipid, inodorous, fixed, difficult to fuse, reducible by the voltaic pile, without action upon the air; at the ordinary temperature, it absorbs a little carbonic acid. This oxide is very rare in nature; it is found only in America. This should not be confounded with *calamine*, which is a silicate and carbonate of zinc. The protoxide of zinc is obtained by heating to redness the fused metal, in a crucible in the open air; the zinc burns with a beautiful green flame, and forms at its surface a wool-like covering; this is gradually taken off with a spatula; a portion of this oxide rises into the atmosphere, and resembles flakes of snow. It was formerly called *flowers of zinc*, (*oxide de zinc sublimé*,) *nihil album*, *philosophorum lana*, &c. It is formed of 100 of metal, and 24·797 of oxygen; it is used in medicine.

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* It is said to be found near Baltimore, in Maryland.

Oxide of Zirconium. (*Oxide de Zirconium, ou Zircone.*) *Zirconia. Zircon.* White, insipid, inodorous, unalterable by imponderable fluids, reducible by potassium. It is said to contain o the metal 100 parts to 65 of oxygen. One method for obtaining it, is to heat in a silver crucible, 1 part of finely powdered zircon with 2 parts of potash; dilute the mass in distilled water, wash and filter it; the residue remaining upon the filter, is composed of silex, zirconia, and the oxide of iron; this is treated by hydro-chloric acid, which dissolves all except the silex; the liquor is filtered again; ammonia is poured into it, which precipitates the zirconia and the oxide of iron, in the state of a hydrate; after being well washed, the latter is separated by oxalic acid; it forms a soluble oxalate of iron, and an insoluble oxalate of zirconia; the washings are repeated, and then by calcination, perfectly pure zirconia is obtained. This substance was discovered by Klaproth.

Oxide of Yttrium. (*Oxide d'Yttrium.*) *Yttria.* White, insoluble, inodorous, insipid, infusible by the heat of the furnace, unalterable by the imponderable fluids; without action upon oxygen gas and combustible bodies; it attracts carbonic acid from the air. It has yet been found only in the *gadolinite*, the *yttro-tantalite*, the *yttro-cerite*. Its preparation is long and difficult. Yttria was discovered by Gadolin, in 1794, and has since been studied by Vauquelin and Klaproth. It was regarded as a simple substance until the discovery of potassium and sodium.

OXIODINE. A name applied by Sir H. Davy, to *anhydrous iodic acid*. It is a semitransparent, inodorous, white substance, with a sour astringent taste. When exposed to a heat of 500°, it fuses and changes into oxygen and iodine.

OXYGEN. (*Oxigène.*) (From the Greek *oxus*, acid, and *gennao*, to produce, because it generates acid.) A colourless gas, inodorous, insipid, invisible; its specific gravity is 1·1026; that of the air being taken for unity. All efforts made to liquefy it have hitherto been vain; when strongly compressed in a glass cylinder, it heats to the luminous point. According to Berzelius, oxygen of all known bodies is the most electro-resinous. This body is unalterable at the highest temperature, by all known agents. It is indispensable to combustion, and to the respiration of animals; of all substances, it acts the most important part in chemistry, being an element of all acids and oxides. Mixed with nitrogen, it constitutes atmospheric air; combined with hydrogen, it forms water; in short, it is one of the constituent elements of all minerals and vegetables. It exists every where; is capable of conbining with all bodies, often in differen proportions.

Oxygen gas was discovered nearly at the same time, by three distinguished chemists. Prieslty, who first discovered it, called it *dephlogisticated* air. Scheele, without any knowledge of the labours of Priestly, discovered it sometime afterward, and called it the *air of fire* (*air de feu.*) The illustrious Lavoisier, after having studied its properties, called it *eminently respirable air*, (*air emi-*

eminemment respirable;) afterward, on account of the acidifying property supposed to belong to this gas exclusively, he designated it by the word *oxygen*, composed of two Greek words, which signify to engender acids. This name being very convenient, has been universally adopted; but since the discovery of the hydracids, and the establishment of the fact that hydrogen and many other substances can produce acids without the aid of oxygen, that general hypothesis has been abandoned, and it has been perceived that the term oxygen, in its strictest sense as signifying *the producer of acid*, is incorrect; this term however having been establised by usage, no attempt has been made to substitute any other name for the important substance which it represents.

Although oxygen is diffused throughout all nature, it is never found in a state of purity; it may be obtained by one of the following processes: 1st. A stone retort is almost filled with the peroxide of manganese; to the neck of the retort is fitted a bent tube, which communicates with the pneumatic cistern; the retort is gradually heated to redness; the gas disengages, passes out at the extremity of the tube, and is collected under a bell-glass or phial filled with water; the first portions of the gas which come over, are rejected on account of being mixed with the atmospheric air which was in the retort and tube, and in some cases also with a little carbonic acid, derived from some carbonates which exist in the oxide of manganese. It is a very good precaution to wash the oxide of manganese with a little diluted muriatic acid, and to dry it before using. The operation of collecting the gas is known to be terminated, when at a red heat oxygen no longer passes over. One pound of the oxide of manganese of commerce ordinarily furnishes from 4 to 5 gallons of this gas.

2d. Another method of obtaining oxygen gas, is to treat the peroxide of manganese with diluted sulphuric acid.

For this purpose a tubulated retort may be one third filled with manganese; the sulphuric acid is poured through the tubulure; the apparatus is fitted as in the preceding case, except that the heat of the sand bath is sufficient to reduce the manganese.

3d. Oxygen gas may be obtained by decomposing at a gentle heat, the chloride of potash in a small retort.

4th. The oxide of silver may be decomposed in the same way. The last two methods furnish oxygen perfectly pure; in the first case the chloride of potasium remains, and in the second the silver is reduced.

5th. Oxygen may be obtained from the red oxide of lead. Pure oxygen is employed only in chemistry; though at the period of its discovery, physicians entertained great hopes respecting its utility in the cure of diseases, particularly that of the lungs; but experience proved that it produced upon these organs too great a degree of excitement, and at length caused the destruction of animals who for any length of time respired it.

Oxygen was discovered in 1774. For an accurate knowledge of this important element of nature, the reader is referred to the chemical treatise of Fourcroy.

Oxygenation. Differs from oxidation, in being a more general term; every union with oxygen, whatever the product may be, is oxygenation; but oxidation take place only when an oxide is formed.

Oximuriates. See *Chlorates* and *Chlorides.*

Oxymuriatic. *Acid Chlorine.*

Oxysulphurets. (*Oxisulfures.*) See *Sulphurets.*

P.

Paints. "In the Philosophical Transactions for 1815, Sir H. Davy has communicated the results of some interesting researches, which he made at Rome, on the colours used by the ancient artists.

He found the reds to be minium, ochre, and cinnabar.

The yellows were ochre, orpiment, and massicot.

The blues were formed from carbonate of copper, or cobalt, vitrified with glass.

The purple were made of shell-fish, and probably also from madder and cochineal lakes.

The blacks and browns were lamp-black, ivory-black. and ores of iron and manganese.

The whites were chalk, white clay, and ceruse.

The Egyptian azure, the excellence of which is proved by its duration for seventeen hundred years, may be easily and cheaply made. Sir H. Davy found that 15 parts by weight of carbonate of soda, 20 of powdered opaque flints, and 3 of copper filings, strongly heated together for two hours, gave a substance of exactly the same tint, and nearly the same degree of fusibility, and when powdered, produced a fine deep sky blue.

He conceived that next to coloured frits, the most permanent pigments are those furnished by the peroxides or persalts, such as ochres, carbonates of copper, patent yellow, (sub-muriate of lead,) chromate of lead, arsenite of copper, insoluble chloride of copper, and sulphate of barytes.

M. Merimé inserted a note very interesting to painters in the "*Annales de Chimie et Phys.*" for June, 1820. When carbonate of lead is exposed for some time to vapours of sulphuretted hydrogen, it becomes black, being converted to a sulphuret. This white pigment, employed with oil, and covered with a varnish which screens it from the air, may be preserved for many hundred years as the paintings of the 15th century prove. But when the varnish is abraded or decays, the whites of ceruse are apt to contract black specks and form spots which ruin fine paintings. Miniatures in water colours are frequently injured in this way. M. Thenard was requested to occupy himself with the means of removing these stains without injuring the rest of the picture. After some trials which proved that the reagents which would operate on sulphuret of lead would equally attack the texture of the paper, as well as the colours, he recollected that among the numerous phenomena which his discovery of oxygenated water had presented to him, he observed the property it possessed, of converting instantly the black sulphuret of lead into the white sulphate of the same metal. He gave a portion of water, containing about five or six times its volume of oxygen to an artist who had a fine picture of Raphael spotted black. On applying a few touches of his pencil, he perceived the stains vanish as if by enchantment, without affecting the other colours in the slightest degree."*

Palladium. A solid metal, of the colour of silver, hard, very malleable, specific gravity 11·3. It has no action upon atmospheric air and oxygen gas; it can only be fused with the gas blow pipe; in this state Vauquelin observed that it burnt with an appearance of brilliant flames (*aigrettes.*) When a jet of hydrogen is passed upon spongy palladium, the metal reddens and water is formed. It has been united to sulphur, chlorine, selenium, and several metals. This metal is very rare, and it has yet only been procured from the ore of platina. It was discovered in 1803 by Wollaston and studied by Vauquelin and Berzelius.

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* Dr. Ure.

Panacea. (*Panacée.*) From the Greek *pan*, all or universal, and *akos*, medicine, signifying *universal medicine*, or one which should cure all diseases. The search for this medicine occupied the attention of many of the alchemists.

Panacea Mercurial. An ancient name for the protochloride of mercury.

Pancreatic Juice. This fluid differs from saliva. According to Tiedemann and Gmelin, its principal constituents are albumen and a curdy substance; it contains also some osmazome. It possesses some acid properties.

Pearlash. An impure potash obtained by lixiviation from the ashes of plants.

Per-Carburets. See *Carburets.*

Per-Nitrites. See *Nitrites* (*Hypo.*)

Per-Oxides. See *Oxides.*

Per-Sulphurets. See *Sulphurets.*

Petrifactions. "Stony matters deposited in the way of incrustation, or in the cavities of organized substances, are called petrifactions. Calcareous earth, being universally diffused and capable of solution in water, either alone or by the medium of carbonic or sulphuric acids which are likewise very abundant, is deposited whenever the water or the acid becomes dissipated. In this way we have incrustations of limestone or of selenite, in the form of stalactites or dropstones, from the roofs of caverns and in various other situations.

The most remarkable observations relative to petrifactions are those given by Kirwan:

1st. That those of shells are found on or near the surface of the earth, those of fish deeper, and those of wood deepest. Shells are found in immense quantities at considerable depths.

2d. That those organic substances that resist putrefaction most, are frequently found petrified; such as shells and the harder species of woods: on the contrary, those that are most apt to putrify are rarely found petrified; as fish, and the softer parts of animals.

3d. That they are most commonly found in strata of marl, chalk, limestone, or clay; seldom in sandstone, still more rarely in gypsum, but never in gneiss, granite, basalt, or schorl; but they sometimes occur among pyrites, and ores of iron, copper, and silver, and almost always consist of that species of earth, stone, or other mineral that surrounds them, sometimes of silex, agate, or cornelian.

4th. That they are found in climates where their originals could not have existed.

5th. That those found in slate or clay are compressed and flattened."*

Petroleum. See *Naphtha.*

Pewter. (*Etain.*) Tin alloyed with copper or other metallic bodies; as lead, zinc, bismuth, and antimony. The French word *etain* being applied both to tin and pewter, the two substances are often confounded.

Pharmacy. (*Pharmace.*) (From a Greek word signifying medicine.) The art of preparing medicine.

Phlogiston. (*Phlogistique.*) (From the Greek *phlogizo*, to burn.) The supposed general inflammable principle of the chemists of the last age; they imagined that it was pure fire, or the matter of fire, fixed in combustible bodies, and distinguished from fire in action, or in a state of liberty. Chemists imagined that in every case of combustion phlogiston was disengaged; on the contrary, whenever a metal was reduced or a body became combustible, they imagined it absorbed phlogiston. It may easily be seen that this theory, although plausible, is erroneous; for were it true, it would follow that bodies after combustion would be diminished in weight, whereas facts prove the reverse of this, as may easily be ascertained by the experiment of burning a metallic wire in oxygen gas; the metal is found to be heavier after combustion.

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* Dr. Ure.

Phocenine. A fetid substance, of an odour resembling that of ether, very soluble in boiling alcohol, without action upon litmus. Phocenine treated by potash is transformed into dry phocenic acid, hydrated oleic acid, and glycerine. It exists in the fat of the porpoise combined with phocenic acid and elaine, and in the oil of the dolphin united to the same substances and to cetine. Phocenine is obtained by dissolving the fat of the porpoise in boiling alcohol, leaving the solution to cool, decanting the alcoholic part, and submitting the residue to distillation. An acid is obtained which is neutralized by magnesia; it is treated with cold alcohol, which dissolves all the phocenine. It was discovered by Chevreul.

Phosgene. A name given by Mr. John Davy to chloro-carbonous gas (*chloroxi-carbonique.*) See *Carbonous Gas.*

Phosphates. Salts resulting from the combination of phosphoric acid with bases. All the phosphates, except those of soda and ammonia, are insoluble; they are affected by fire like the borates. Carbon at a high temperature decomposes them; with the metals of the last four sections, whose oxides are reducible by charcoal, it produces carbonic acid, and forms metallic phosphurets; but with the oxides of the first two sections, which are not reducible by charcoal, it disengages phosphorus and the oxide gas of carbon, while a sub-phosphate remains. Liquid phosphoric acid dissolves all the phosphates. All the strong acids unite with one part of the base of the neutral phosphates, forming soluble acid phosphates. These salts are extensively diffused in nature; the phosphate of lime is most abundant, sometimes constituting whole mountains, and forming an important part of all animal bones. There are phosphates with an excess of the base, neutral phosphates, acidulated phosphates, and acid phosphates. The soluble phosphates are prepared by adding the base to a solution of the acid phosphate of lime. Those which are insoluble are obtained by double decomposition.

According to Berzelius, in the neutral phosphates the oxygen of the oxide is to the oxygen of the acid as 2 to 5. The sub-phosphates contain once and a half as much of the base as the preceding; the acid phosphates contain only half as much of the base as the neutral phosphates; and the acidulated phosphates, three quarters.

Phosphate of Alumine. This salt exists in nature; it constitutes almost wholly a mineral called *wavelite*. Vauquelin discovered it in a mineral brought from the island of Bourbon. It can be obtained only by decomposition.

Phosphate of Ammonia. (*Phosphate d'Ammoniaque.*) Solid, white, without action upon atmospheric air; it greens the infusion of violets. Exposed to the action of fire, it disengages all the base, the phosphoric acid remaining fused and transparent. It is obtained by pouring liquid ammonia into the acid phosphate of lime; the sub-phosphate of lime is precipitated, separated by filtering the liquor, and afterwards suitably evaporated and crystallized. A slight excess of ammonia should be added; because by evaporation the salt soon becomes acid. The phosphate of ammonia is employed to obtain phosphoric acid. Gay-Lussac has demonstrated that any kind of cloth impregnated with phosphate of ammonia is incombustible. At the approach of a burning body the salt decomposes; all the ammonia is disengaged; and the phosphoric acid covers the tissue with a kind of varnish which opposes the action of fire.

Phosphate Ammoniaco-Magnesian. White, solid, semi-transparent, vitrifiable at a red heat. By trituration with an alkali it disengages ammonia; it is soluble in sulphuric acid, and insoluble in a solution of the alkalies, and is prepared by saturating the acid phosphate of magnesia with ammonia.

Phosphate of Barytes. (*Phosphate de Baryte.*) Solid, white, pulverulent, insipid, without action upon atmospheric air and upon vegetable colours, insoluble in cold and boiling water. Treated with ammonia, it passes to the state of a sub-phosphate. Phosphoric acid and the strong acids transform it successively into an acidulated phosphate and an acid phosphate of barytes. This salt is obtained by decomposing a solution of neutral phosphate of ammonia, by another solution of the chloride of barium, equally neutral; the phosphate of barytes precipitates, and is separated by filtering. Besides the neutral phosphate above described, there are two acid phosphates of the same base. They are obtained by processes analogous to the preceding.

Phosphate of Copper. (*Phosphate de Cuivre.*) Green, insoluble, unalterable by the air; crystallizing in rhomboidal prisms, or in rectangular octoedrons. It is found native in Hungary and many other countries, but usually in small quantities. This phosphate may be obtained by double decomposition. According to Berthier, it consists of 64 parts of phosphoric acid and 29 of the deutoxide of copper.

Phosphate of Cobalt. Blue of Thenard, or Cobalt blue. See *Blue.*

Phosphate of Iron. (*Phosphate de Fer.*) Blue, sometimes in crystals, sometimes in amorphous (shapeless) masses. The crystals are usually in the form of rectangular prisms. This phosphate is insoluble in water, unalterable by air; it is a rare substance, is found in the mines of Cornwall, England, in micaceous rocks associated with magnetic sulphuretted iron; in Bavaria, and in the volcanic products of the island of Bourbon. In a pulverulent state it is found only in the argellites of the newest formation. According to Fourcroy it consists of 22 parts acid, 44 of the protoxide of iron, and 34 of water. This salt may be artificially obtained by decomposing a solution of the sulphate of iron by the phosphate of soda or potash. It has no use in the arts or in medicine.

Phosphate of Lead. (*Phosphate de Plomb.*) This varies in colour, sometimes it is green, sometimes brown, yellow, &c. It usually contains the arseniate of lead. It is found in France, in the Hartz mountains, and in the Lead Hills of Scotland.* It crystallizes in hexahedral prisms more or less regular. Klaproth, who analyzed this natural phosphate, found it formed of 76 of the oxide of lead and 24 of phosphoric acid. It is prepared by double decomposition. A sub-phosphate of lead is obtained by boiling the native phosphate with ammonia.

Phosphate of Lime. (*Phosphate de Chaux.*) White, pulverulent, insipid, without action upon vegetable colours. It acts with the acids like the phosphate of barytes. This salt does not exist in nature. It is prepared by pouring a solution of the chloride of lime into a solution of the neutral phosphate of soda; the phosphate of lime is immediately precipitated. Berzelius observes, that if we should invert this process, that is, should pour the phosphate of soda into the chloride of lime, only the phosphate with an excess of the base would be precipitated, and the liquor would become acid. It consists of 100 of acid and of 79·838 of lime. Berzelius, besides these neutral phosphates, admits four others; two *sub-salts* and two *super-salts*. One of these sub-salts is sometimes found crystallized; in this state it is known by mineralogists by the name of *apatite*. The same sub-phosphate of lime constitutes almost all the hard parts of bones. It is of much use in the arts. Chemists usually xtract phosphorus from the sub-phosphate of lime. See *hosphorus.*

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* It is found in some parts of the United States, as in the lead mines of Pennsylvania and of Southampton in Massachusetts.

Phosphate of Potash. This salt is known only in olution; when an attempt is made to crystallize it during vaporation, it separates into an acid phosphate which rystallizes, and an alkaline phosphate which is deposited n the form of a jelly. It has a strong taste and is undeomposable by fire. According to Saussure, it can disolve a quantity of lime and form a phosphate of calcaeous potash. The same chemist dissolved a large quanity of the phosphate of lime by boiling it with potash; but the calcareous phosphate must be hydrated, otherwise the cohesion would be too strong, and there would be little or no action. It exists in the seeds of the *cerealia*, or the gramineous vegetables, and is prepared by pouring a solution of the sub-carbonate of potash into the acid phosphate of lime. It can also be obtained by a direct process.

Phosphate of Soda. (*Phosphate de Soude.*) Crytallizes in rhomboidal prisms, transparent, rendered soluble by heat. Exposed to the air, this salt parts with a portion of its water of crystallization and effloresces. Submitted to the action of fire it first undergoes the aqueous, then the igneous fusion; at a cherry red it produces an opaque glass. The phosphate of soda greens the infusion of violets, for this reason Thenard considers it as a sub-phosphate. It is prepared by calcining bones in a furnace; when very friable, they are reduced to a fine powder, sifted, mixed with water and two thirds of their weight of sulphuric acid; the mass becomes heated, swells, and disengages carbonic acid from the carbonate of lime contained in the bones; the mass is again diluted with water and filtered; all the lime remains upon the filter while the acid phosphate of lime, which is very soluble, passes through. Into this solution is poured carbonate of soda, until the liquor becomes so alkaline as to green strongly the infusion of violets; a violent effervescence takes place, followed by a gelatinous precipitate of the phosphate of lime; it is again filtered, the precipitate washed and suitably evaporated; the phosphate of soda in a day or two crystallizes. If the mother-waters were acid or even neutral, it would be necessary to add a new quantity of the carbonate of soda. This salt is used in the arts for the preparation of cobalt blue (Thenard's blue). It is employed in medicine.

Phosphate of Uranium. (*Phosphate d'Urane.*) It exists in nature in small quantities. It is crystallized in lamellar clusters. It is of a yellow or green colour; in the latter case, it contains copper, such as that of England and Siberia. Phillips, who analyzed this natural phosphate, found it composed of 10 parts of phosphoric acid, 75 of the deutoxide of uranium, and 15 of water.

Phosphate of Yttria. The substance formerly described by Berzelius under the name of *Thorina*, has since been ascertained to be a phosphate of yttria.

Phosphites. Salts resulting from the action of phosphorous acid, with salifiable bases. All the phosphites, exposed to heat, disengage phosphuretted hydrogen and a little of phosphorus, and a phosphate coloured by the oxide of phosphorus remains. The phosphites thrown upon burning coals, produce a yellow flame, which is intense in proportion to the quantity of acid. The phosphites of potash, soda, and ammonia, are excessively soluble; it is even impossible to crystallize the first. Those of strontian, lime, and barytes, can crystallize only by spontaneous evaporation; at 212° they separate into acids, phosphites, and sub-phosphites. Gay-Lussac observed that the phosphites could absorb oxygen gas, and become phosphates, without any particular change at the points of saturation. All these salts are the products of art; they are either obtained directly, or by double decomposition. It has been observed by some chemists, that the oxides easily reducible, cannot combine with phosphorous acid. According to Berzelius, in the phosphites, of the oxygen of the acid as 2 to 3. See Memoirs by Dulong and Gay-Lussac.

Phosphites (Hypo.) Combinations of hypo-phosphorous acid with bases. These salts have been studied only by Dulong; they are acted upon by fire like the phosphites, and like them they disengage phosphuretted hydrogen and phosphorus, being changed into phosphates coloured by the oxide of phosphorus, but their volatile products are more abundant than in the phosphites. Upon burning coals they produce like the phosphites, a yellow flame. They are so soluble that they cannot be crystallized; they transform chlorine to hydrochloric acid and possess the property of reducing the salts of gold and silver. The hypo-phosphites are all the products of art; they are prepared by a direct process.

Phosphorus. (*Phosphore.*) (From the Greek *phos*, light, and *phero*, I carry.) A solid body, white, sometimes yellowish or reddish. It is flexible, of the consistence of wax, may be cut with a knife, or broken by the fingers. Its specific gravity is 1·770; it liquifies at 1[illegible] and according as it cools slowly or quickly, it takes different shades from white to black. Phosphorus may be crystallized in little octoedral needles. If fused in a [illegible] with water, it appears like a white oil; and occupies, on account of its specific gravity, the lower part of the vessel; by shaking it in this state until the water is cold, is converted into a powder more or less fine. At a temperature a little more elevated, the phosphorus volatilizes; by this property chemists are able to purify it; but it is necessary to use a retort deprived of air, as in contact with the air it inflames. To the retort is added a receiver full of water in order to condense the phosphorus.

Light has an important effect upon phosphorus, turning it red when excluded from all contact with the air. When exposed to the air phosphorus becomes luminous, and burns without being inflamed. It does not, at the [illegible] dinary pressure, burn in oxygen gas at a temperature below 80°; but if the pressure is diminished, phosphorus becomes luminous in the dark, and burns. Nitrogen, by rarefying the oxygen of the atmosphere, acts like the diminution of pressure, and singularly favours combustion. When a small piece of phosphorus is burned on a plate under a bell-glass filled with oxygen, all the oxygen is absorbed and solidified; the sides of the bell-glass are covered with phosphoric acid; and on the plate remains a reddish substance, which is the oxide of phosphorus. Hydrogen brought in contact with phosphorus, dissolves a portion and changes it to phosphuretted hydrogen (*hydrogène phosphoré*); some red star-like crystals are deposited, which M. Vogel regarded as the oxide of phosphorus.

Phosphorus forms combinations with most other combustible bodies. It has not been discovered pure in nature. Combined with oxygen, it enters into the combination of many minerals, and forms a great part of the animal frame; united to oxygen, hydrogen, carbon, nitrogen, it constitutes a part of the nerves and brains of fish. Phosphorus is employed in the arts for the construction of phosphoric matches; in chemistry for the analysis of air and the preparation of phosphoric acid. Its use in medicine has been attempted, but according to the experiments of Pelletier and others, it too highly irritates the animal organs. Phosphorus was discovered by Brandt, an alchymist, at Hamburg. Scheele and Gahn first obtained from it bones.

PHOSPHORUS of BAUDOUIN. See *Nitrate of Lime*.

PHOSPHORUS of BOLOGNA. See *Sulphate of Barytes.*

PHOSPHORUS of HOMBERG. See *Chloride of Calcium.*

PHOSPHURETS. (*Phosphures.*) Combinations of phosphorus with combustible bodies. Phosphorus unites with metallic combustibles, and to combustible bodies non-metallic. All the metallic phosphurets are brittle, solid, and more fusible than the metals they contain, when those are fused with difficulty; in the other case they are less fusible; thus, the phosphuret of iron is more fusible than iron; while that of tin or lead is sensibly less fusible than lead or tin, taken in their separate state. These compounds have been but imperfectly studied; yet there is reason to believe that they are subject to the same laws of composition as the sulphurets; of course there may be as many phosphurets of a metal as there are sulphurets and oxides of the same metal; or, which is the same thing, a proto-phosphuret, in absorbing the quantity of oxygen proper to burn the metal and phosphorus, may be changed into a neutral proto-phosphate. (Dulong.) All the phosphurets are insipid, except those of the alkaline metals, which decompose water of the ordinary temperature; some are susceptible of decomposition by fire. It is probable that all the phosphurets, at an elevated temperature, can obsorb oxygen gas and become phosphates. The phosphurets were discovered by Pelletier; they are all the products of art. Various processes are used for obtaining them:

1st. Dulong advises to make phosphorus in a state of vapour pass upon the metal heated to redness.

2d. The metal to be phosphuretted is to be minutely subdivided and melted if it is fusible; if not fusible, the metal should be heated to redness and phosphorus added in small proportions; one part of the phosphorus inflames and the other combines with the metal. Phosphorus is added until the metal will absorb no more. When the metal oxidates easily by heat, a little resin is added in order to preserve it from contact with the air.

3d. A neutral phosphate is treated with lamp-black in a crucible lined with carbon; at a high temperature the carbon unites with the oxygen of the metal and phosphoric acid.

4th. Phosphurets whose metals have little affinity for oxygen, are prepared by passing a current of phosphuretted hydrogen into a solution of the salt.

Phosphuret of **Antimony**. (*Phosphure d'Antimoine.*) White, of a metallic appearance, crystallizes in little cubes. It is very fusible, and decomposes by fire. It is obtained by fusing antimony in a Hessian crucible, and throwing upon it by degrees dry phosphorus. It must be taken from the fire as soon as the last portions of phosphorus are added.

Phosphuret of **Arsenic**. (*Phosphure d'Arsenic.*) Grayish black; it decomposes so easily that it cannot be preserved except under water. It is obtained by heating under water equal parts of phosphorus and the deutoxide of arsenic; one part of the phosphorus absorbs the oxygen of the arsenic and passes to the state of phosphoric acid, which dissolves in the water; the other part of the phosphorus unites to the reduced metals. This phosphuret may be prepared by heating equal parts of phosphorus and arsenic in a small glass retort.

Phosphuret of **Bismuth**. (*Phosphure de Bismuth.*) Black, pulverulent, decomposes at a moderate heat. It is obtained by decomposing a salt of bismuth with phosphuretted hydrogen; it is filtered to separate the precipitate, washed and dried with a gentle heat.

Phosphuret of **Cobalt**. (*Phosphure de Cobalt.*) Bluish white, brittle, more friable than cobalt; at a high temperature it absorbs oxygen and becomes a phosphate of cobalt. It is obtained by strongly calcining, in a crucible lined with charcoal, (*creuset brasqué,*) a mixture of 4 parts of dry phosphoric acid, 4 parts of cobalt, and half a part of charcoal. It can also be obtained by passing the vapour of phosphorus upon cobalt heated to redness.

Phosphuret of **Copper**. (*Phosphure de Cuivre.*) White, brittle, very hard and brilliant. When exposed to a great heat in the air, it produces a phosphate of copper. Dulong obtained it by passing vapour of phosphorus upon copper filings heated to redness in a porcelain tube. That which is prepared by throwing phosphorus upon the heated metal is not saturated with phosphorus.

Phosphuret of **Gold.** (*Phosphure d'Or.*) Black, pulverulent, decomposes at a gentle heat; it is obtained by heating gold to redness in a porcelain tube, and introducing the vapour of phosphorus. Thenard considers this phosphuret as not saturated, and directs that a current of phosphuretted hydrogen shall be passed into a solution of the chloride of gold.

Phosphuret of **Iodine.** (*Phosphure d'Iode.*) Iodide of phosphorus.

Phosphuret of **Iron.** (*Phosphure de Fer.*) Bluish gray, of a granular fracture, brittle, unalterable by the air, without action upon the magnetic needle; decomposable by nitro-muriatic acid and charcoal. It is obtained by powerfully heating 4 parts of the phosphate of iron with one of lamp-black in a crucible with charcoal; if the charcoal is in excess, a mixture of the phosphuret and carburet of iron will be obtained; this may be separated by muriatic acid which dissolves the latter without attacking the former. It may be prepared by heating iron to redness in a porcelain tube, and introducing the vapour of phosphorus.

Phosphuret of **Lead.** (*Phosphure de Plomb.*) Bluish white, more brilliant than the metal, little ductile, less fusible than lead, decomposable at a high temperature; the action of the air transforms it into the phosphate of lead. It is prepared by throwing small pieces of phosphorus into lead in a state of fusion.

Phosphuret of **Manganese.** (*Phosphure de Manganèse.*) Brilliant, very brittle, much more fusible than manganese; without action upon the air at the ordinary temperature; it is obtained in the same manner as the phosphuret of iron.

Phosphuret of Mercury. (*Phosphure de Mercure.*) Black, of little consistence. It decomposes in contact with the air, diffusing phosphoric acid in white vapours. It is obtained by heating phosphorus under water, with the deutoxide of mercury. Thomson denies the existence of this phosphuret; he considers the compound thus produced as an intimate mixture of phosphorus and mercury, or rather as the ***black oxide of mercury.***

Phosphuret of Nickel. [*Phosphure de Nickel.*] Brilliant, brittle, more fusible than nickel, crystallizes in little annular prisms; at an elevated temperature it is transformed into a phosphate of nickel. It is obtained by passing the vapour of phosphorus upon the metal heated to redness, or by decomposing a salt of nickel by phosphuretted hydrogen.

Phosphuret of Platina. (*Phosphure de Platine.*) Of a grayish white, very hard, brittle, of a granular texture, more fusible than the metal. It decomposes at a high temperature. It is prepared by subjecting to an intense heat 8 parts of phosphoric acid with 8 parts of platina and 1 part of lamp-black. Mr. Edmond Davy admits two phosphurets of platina. Platina having a great tendency to combine with phosphorus, it follows that platina crucibles should not be used for preparations containing this substance.

Phosphuret of Potassium. (*Phosphure de Potassium.*) Dark brown, of a sharp and caustic taste; it is easily reduced to powder. Heated in the air, it absorbs oxygen gas and becomes phosphate of potash. It decomposes water at the ordinary temperature, throwing off phosphuretted hydrogen, which inflames spontaneously. It is obtained by heating phosphorus and potassium in a small retort.

PHOSPHURET of SELENIUM. (*Phosphure de Selenium.*) Berzelius is the only chemist who has prepared this phosphuret. Phosphorus can combine with selenium in all proportions. It is very fusible, has a metallic brilliancy and glassy fracture; water decomposes it into phosphoric acid and hydro-selenic acid.

PHOSPHURET of SILVER. (*Phosphure d'Argent.*) More fusible than this metal. White, brittle, granular; it decomposes at a high temperature. It is obtained by throwing small pieces of phosphorus upon filings of silver heated to redness.

PHOSPHURET of SODIUM. (*Phosphure de Soude.*) It possesses all the physical and chemical properties of the phosphuret of potassium, and is prepared in the same manner.

PHOSPHURET of SULPHUR. (*Phosphure de Soufre.*) Sulphur, like selenium, combines with phosphorus in many proportions, of course it may be supposed that the phosphuret of sulphur varies much in its properties; sometimes it is liquid, sometimes solid, of a yellow colour, more or less dark; it is always heavier than water. If the temperature is but little increased, it volatilizes; oxygen gas decomposes it into sulphurous and phosphoric acids, with an elimination of light and heat; it inflames by contact with the air. Great precaution should be taken in the preparation of this phosphuret, on account of danger from its explosion. To avoid this accident, the substances should be heated under water, having previously moistened the flowers of sulphur that it may not swim upon the surface; the heat is raised to about 140°, and the mixture is stirred with a tube in order to favour the combination. Phosphuret of sulphur can also be prepared by melting phosphorus in a small glass tube, and adding by degrees small bits of sulphur; it is necessary to wait till each fragment shall have combined before adding another; a slight noise like that made by plunging hot iron into water gives notice that the combination has taken place.* This phosphuret was discovered by Margraff, studied by Pelletier, Thenard, Faraday, and many other chemists, whose labours are recorded in the Journals of Chemistry and Physics.

Phosphuret of Tin. (*Phosphure d'Etain.*) In external appearance resembling silver; it separates into thin scales by the action of the hammer; when fused, it crystallizes like antimony into a resemblance of fern leaves: at a high temperature it absorbs oxygen gas and becomes a phosphate of tin. This phosphate is a little ductile; for this reason Thenard regards it as not saturated by phosphorus. It is prepared by throwing small fragments of phosphorus into melted tin. (*Pelletier.*)

Phosphurets of Titanium, of Tungsten, and of Molybdenum. Scarcely known; it is only ascertained that they exist.

Phosphuret of Zinc. (*Phosphure de Zinc.*) Bluish white, slightly malleable, decomposable at a great heat. It is prepared by putting small fragments of phosphorus upon zinc melted and covered with resin to prevent its oxidation. A better method of preparing it is to decompose a salt of zinc by a current of phosphuretted hydrogen. (*Pelletier.*)

Photometer. An instrument constructed by Leslie, he supposing that light, when absorbed, produces heat. One of the bulbs of his differential thermometer is blackened; this when exposed to the light, becoming warmer than the clear bulb, indicates the effects of the depression of the fluid.

Phtore. A name formerly given to the supposed base of fluoric acid; it is now called *fluorine.*

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* The authors state however that this process is not without danger, as one of them, in the use of it, had nearly fallen a victim to a violent explosion.

Physiology. (From the Greek *phusis*, nature, and *logos*; a discourse.) The science which has for its object the knowledge of the phenomena of organic bodies. It is divided into *vegetable* and *animal* physiology; chemistry, so far as it investigates the elements of organic matter, is a branch of physiology.

Picromel. (From the Greek *pikros*, bitter, and *megi*, honey, so called from its peculiar taste.) A substance without colour, of the consistence of turpentine, of a nauseous smell, a sharp, bitter, and sugared taste, of a greater specific gravity than water. Exposed to the action of fire, it decomposes and furnishes a few azotic products. It attracts moisture from the air and is insoluble in water and alcohol; it is not precipitated from its solution by the acetate of lead, infusion of nutgalls, or the alkalies; the sub-acetate of lead, the salts of mercury and iron, are the only agents which precipitate this substance. Picromel treated with acids at a mild heat become a viscous mass, almost insoluble in water.

Picromel exists in the bile of man, the ox, and probably in that of all animals. It is usually prepared by pouring into the bile of the ox, neutral acetate of lead, which precipitates a yellow and resinous matter, and sulphuric and phosphoric acids. The liquor contains all the picromel; this is filtered and mixed with the sub-acetate of lead; it forms a flosculous precipitate composed of the oxide of lead and picromel; this after being washed with many waters is dissolved in diluted acetic acid; a current of sulphuretted hydrogen is passed into the solution; this precipitates the metal in the state of a sulphuret; it is then only necessary to filter and heat the liquor in order to vaporize the acids, and obtain pure picromel. According to Thomson, this substance consists of

Carbon,	53·54
Hydrogen,	1·82
Oxygen,	45·65

It was discovered by Thenard.

Picrotoxine. *Picrotoxia.* Solid, transparent, brilliant; crystallizes in quadrangular prisms, its taste is insupportably bitter. Submitted to the action of fire, it acts like the resins; it gives no ammoniacal products. It easily dissolves in alcohol; boiling water dissolves $\frac{1}{25}$ and cold water $\frac{1}{56}$ of it. It exists in the fruits of the *Menispermum cocculus.* According to Orfila it is of a nature so deleterious that the smallest quantity will destroy animal life.

Piperine. (From *piper*, the Latin name for pepper.) Solid, transparent, insoluble in cold water, hardly soluble in boiling water; but dissolves in ether and alcohol. It is procured by treating pulverized black pepper with boiling alcohol, filtering and evaporating the solution to dryness. The brown mass resulting from the evaporation is treated with water, and the part not dissolved is afterwards treated with boiling alcohol, which dissolves all the piperine; on cooling, it crystallizes in elongated prisms. It is purified by many times repeating the process.

Pipette. A glass bulb with which are connected two little glass tubes, one of which is bent and the other straight. This instrument is used for decanting liquids; the straight end is introduced into the liquid; at the other end the operator sucks with the mouth, until the bulb is nearly filled with the liquid, the aperture is then closed with the tongue, the pipette is withdrawn from the liquid and its contents discharged by the straight tube into the vessel destined to receive it.

Plaster of Paris. See *Sulphate of Lime.*

Platina. (*Platine.*) This metal was so called by the Spaniards from the word plata, silver, which it resembles in colour; or from the river Plata, near which it is found. Platina is a solid metal of a silvery whiteness, very ductile, very malleable; it is so soft that it may be cut with scissors, or scratched with the nails; it is unalterable by the air at all temperatures. It is the heaviest substance known in nature; its specific gravity is 20·98; it is infusible at the most intense heat of the furnace; it has never been fused but by the gas blow-pipe. It unites to metals and forms alloys; among combustible non-metallic bodies, it has been combined only with boron, sulphur, phosphorus, chlorine, selenium, and iodine. This metal, like palladium, possesses the property, when in the spongy state, of inflaming hydrogen gas at the ordinary temperature.

Platina ore is found in nature combined with the four new metals *iridium*, *rhodium*, *palladium*, and *osmium*, and also iron and chromium. The ore of platina is in flat grains; the largest piece of platina known, weighed one pound and nine ounces: this was discovered by a negro slave, in the gold mines of Condoto. Platina ore has been seldom found except in America. The places where it has been most common are Peru, Carthagena, and Brazil. Vauquelin discovered it in silver ore from Spain, in which, it constituted one tenth of the metal.

Platina was first discovered by Wood, an assayer in Jamaica, in the year 1741; but Don Antonio Ulboa first described its existence, in the narrative of his voyage to Peru, with the French academicians. Most chemists have studied the properties of this metal; rhodium and palladium were discovered in it by Bergmann, Lavoisier, &c.; iridium was discovered in it by Descotils, and osmium by Tennant. Various processes for the extraction of platina have been described. Those who may wish to learn these methods are referred to the works of Thenard, Vauquelin, and Wollaston. As the newly discovered metals iridium, rhodium, &c., exist in the ore of platina, the process for obtaining the former are connected with that of extracting the latter metal.

The property of platina to resist the most intense heat, and the action of the most powerful acids, renders this substance very precious in the arts; in chemistry it is used for retorts, crucibles, capsules, and tubes; it is used for the evaporation of sulphuric acid, &c.; but unfortunately this metal is still too rare to be of use in domestic economy.

Plomb. See *Lead.*

Plumbago. (*Plombaginé.*) (From *plumbum*, lead.) *Black lead.* A name given in the arts to the *per-carburet of iron.* It is an ore of a shining blue colour, greasy to the touch. It is chiefly found in primitive rocks. In mineralogy it is called *graphite.* It is used in the manufacture of black lead pencils and crayons.

Pluranium. Recently discovered by Osann. It is obtained from platinum, and is a grayish coloured metal. It forms an oxide and sulphuret; its farther properties are not known.

Pneumatic. (From the Greek *pneuma*, wind; relating to air.) Of, or belonging to air or gas.

Poison. (*Poison*, French; *Venenum*, Latin.) This name is given to substances which, taken internally or applied externally, derange the vital functions, producing serious accidents, and even death. We have been careful in describing each poisonous substance to remark upon its venomous property, and to point out the principal agents by which its presence may be detected. To those who would wish to investigate the subject more fully, the learned treatise on Toxicology of Professor Orfila is particularly recommended.*

Pollenin. The pollen of tulips has been ascertained by Professor John, to constitute a peculiar substance, insoluble in alcohol, ether, water, oil of turpentine, naphtha, or carbonated and pure alkalies; it is extremely combustible, burning with great rapidity and much flame, and hence used at the theatres to imitate lightning.

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* Toxicology includes the study of the nature of poisons, their mode of operations and antidotes. Most writers on poisons have drawn their facts chiefly from the treatise above recommended.

Polychroite. A red pulverulent substance, of a slightly bitter taste, inodorous, colouring the saliva yellow. It is a little soluble in cold water, more so in boiling water; is dissolved by alcohol and ether, also by the alkalies and fixed and volatile oils. Exposed to heat, it acts like vegetable substances. Vegetable acids dissolve one part of the polychroite; the solution, by the addition of an alkali, precipitates all the colouring matter. Nitric acid gives it a green colour, which disappears on diluting it with water, and re-appears by a new quantity of the same acid; sulphuric acid at first communicates to it a blue colour; it then passes to a violet; chlorine entirely deprives it of colour. This substance is obtained by treating the aqueous extract of saffron with alcohol at 104°; evaporating three fourths of the liquor, mixing a little potash and soda, in order to separate the essential oil, pouring in acetic acid to saturate the alkali, and washing the residue with many waters.

Pompholix. A name formerly given to the oxide of zinc. (See this word.)

Potash. Protoxide of potassium. (See this word.)

Potash Vitriolated. Some ancient chemists gave this name the sulphate of potash.

Potassium. A solid metal, very ductile, lighter than water, softer than wax, of a steel gray colour; when newly cut, it has great metallic brilliancy. It tarnishes easily on exposure to the air, becomes bluish, and soon changes into a white protoxide commonly called potash. When heated in contact with oxygen gas, the absorption is instantaneous; much caloric and light are disengaged, and the result is a deutoxide of potassium. Atmospheric air, at the ordinary temperature, acts upon potassium like oxygen gas; but in proportion as the metal oxidates, it absorbs carbonic acid from the air, and passes to the state of a proto-carbonate. Potassium heated in a small retort, with the oil of naphtha, fuses at 138°; at a temperature a little elevated, it sublimes, diffusing green vapours. Boron and carbon have no effect upon potassium; it is the same with nitrogen, in a phial of which, notwithstanding the combustible nature of that metal, it may be preserved. There does however exist a combination of nitrogen, ammonia, and potassium.

If potassium is heated in close vessels with a *little* phosphorus, the result will be a phosphorus of a brown chestnut colour, easy to be reduced to powder, and without any metallic appearance. Sulphur acts upon potassium like phosphorus, producing a reddish yellow sulphur. Iodine, aided by heat, unites to potassium with a great elimination of light and caloric, producing a white iodide of a pearly appearance.

By moderately heating potassium in hydrogen gas, and gently agitating it, a gray hydruret without a metallic appearance is formed. According to M. Sementini, hydrogen can unite to this metal in two other proportions, producing proto and deuto potassuretted hydrogen gases; it is with respect to these gases as with the proto and deuto phosphuretted hydrogen; the first of them inflames only at the approach of a burning body, while the second inflames spontaneously; in both cases there is a formation of water and the protoxide of potassium.

When potassium at the ordinary temperature is agitated in chlorine, much caloric and light are disengaged; the chlorine is solidified, forming a chloride of potassium, similar in all respects to the saline compound known as *the febrifuge salt of Sylvius.* All the gaseous hydracids are with heat decomposed by potassium; it abstracts their base in order to form a chloride, an iodide, or a sulphuret of potassium; hydrogen is disengaged. Potassium also decomposes the anhydrous* or gaseous acids; it takes oxygen from water, sometimes disengaging the base; but with boracic acid it forms boron and a sub-borate of potash; with phosphoric acid it forms phosphorus and the phosphuretted protoxide of potassium.

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* Anhydrous signifies without water.

One of the most important properties of potassium is the facility with which, at the ordinary temperature, it decomposes water. If some fragments of potassium are thrown into a vessel of water, action immediately takes place, the metal rises to the surface of the water, which decomposes with a slight explosion. So much caloric is disengaged, that the hydrogen gas resulting from the decomposition of the water is inflamed; the water which remains, contains the protoxide of potassium in solution.

We are indebted to Sir H. Davy for the discovery of potassium; previously potash had been considered as a simple substance.

Potassium may be obtained by the following process: a piece of potash, having a small cavity filled with mercury, is placed upon a metallic plate; the positive pole of the voltaic pile is brought in contact with the plate, and the negative with the mercury; as soon as the pile commences action, decomposition takes place; the mercury solidifies; it is then put into the oil of naphtha; new mercury is placed in the cavity of the potash; the potassium is separated from the mercury by distilling it in a very small retort with the oil of naphtha. By this process only a very small quantity of potassium can be obtained with a great degree of labour. The following is a more simple manner of obtaining potassium: if a thin piece of solid hydrate of potassa be placed between two discs of platinum, connected with the extremities of a voltaic apparatus of 200 double plates, four inches square, it will soon undergo fusion; oxygen will separate at the positive surface, and small metallic globules will appear at the negative surface; these are potassium.

Gay-Lussac and Thenard, in 1810, discovered a more expeditious mode of procuring potassium, by heating iron filings to whiteness in a curved gun-barrel, causing melted potash to be slowly brought into contact with the iron, air being excluded; potassium is formed and collected in the cool part of the tube. For more particular directions with respect to this last process, the reader is referred to Thenard's "*Traité de Chimie.*"

Potassium is employed in chemistry in order to absorb oxygen from some bodies which cannot be deoxidized by any other means. Both by analysis and synthesis potassa is proved to be a compound of oxygen, with the peculiar inflammable base potassium.

Potassuretted Hydrogen. (*Hydrogène Potassié.*) A name given by Sementini to a gas which is obtained by treating at a high temperature, the hydrated protoxide of potassium with iron filings, as in the extraction of potassium. The existence of this gas seems doubtful; if it does exist, it is but ephemeral.

Potential Cautery. Caustic potash.

Powder. (*Poudre.*) See *Gunpowder*.

Precipitate White. (*Précipité Blanc.*) A name formerly given to a precipitate which was obtained by pouring a solution of common salt into the nitrate of mercury; a precipitate was formed, which was washed, in order to separate the nitrate of soda, and the corrosive sublimate, which always in a greater or less quantity, was formed during this operation. See *Proto-chloride of mercury*.

Precipitate Per Se. Red Oxide of Mercury by heat.

Precipitate Purple of Cassius. Chloride of Gold.

Precipitate Red. (*Precipité Rouge.*) A name given to the deutoxide of mercury.

Precipitation. (*Precipitatio*, from *precipito*, to cast down.) When two bodies are united, for instance, an acid and an oxide, and a third body is added such as an alkali, which has a greater affinity for the acid than the metallic oxide has, the consequence is, that the alkali combines with the acid, and the oxide thus deserted, appears in a separate state at the bottom of the vessel in which the operation is performed. This decomposition is commonly known by the name of precipitation, and the substance that sinks, is named a precipitate. The substance, by the addition of which the phenomenon is produced, is denominated the precipitant.

Principles. (*Principia.*) *Primary substances.* Substances or particles which are composed of two or more elements; thus water, gelatine, sugar, fibrine, &c., are the principles of many bodies. These principles are composed of elementary bodies, as oxygen, hydrogen, azote, &c., which are undecomposable.

Prussiates. Before the discovery of cyanogen, the compounds which we have described as *cyanides* and *hydro-cyanates*, were termed prussiates. They are salts formed by the union of prussic (hydro-cyanic) acid, or the colouring matter of prussian blue, with a salifiable basis.

Prussic Acid. See *Acid Hydro-Cyanic.*

Prussine. *Prussic Gas. Cyanogen.* (See this word.)

Pyrometer. (From the Greek *pur*, fire, and *metron* measure.) An instrument for measuring degrees of heat, to which the thermometer cannot be applied. The most celebrated instrument of this kind, is Wedgewood's.

Pyrophorus. (*Pyrophore.*) A chemical combination which possesses the singular property of inflaming spontaneously when in contact with the air. It is said to be composed of sulphuret of potassium, of alumine, and a finely powdered carbonate. It was discovered by Homberg. Tthis chemist having been engaged in some analyses with various substances, was surprised some days afterwards, when on taking from a cold retort the *caput mortuum* of one of his mixtures, to see it immediately take fire; he recollected that this residue, was that of a mixture of alum and animal matter which he had distilled. He repeated the process and obtained the same result. When assured of his success, he published his discovery, which was repeated by many chemists. For a long time they scrupulously followed the process of Homberg; but Lemery demonstrated that for the animal matter, sugar, honey, farina, &c., might be substituted. At present pyrophorus is prepared by mixing 3 parts of alum, based on potash, with 1 part of sugar or molasses, drying the mixture over the fire in an iron pan, till it begins to burn; it must be carefully stirred during the operation; it is then pulverized, and a phial or matrass is about three quarters filled, and covered with a tube; this phial is placed in the furnace, gradually surrounded with burning charcoal; it is heated until a blue flame, which appears in the neck of the phial, begins to disappear; the the phial is then withdrawn from the furnace, closely stopped, and left to cool. The pyrophorus may be preserved a long time if kept from contact with the air. It is well made, if on pouring a very little upon paper it instantly takes fire; but if it only heats the paper or takes fire with difficulty, it is not good. Damp air favours its inflammation.

Pyro-Tartrates. Combinations of pyro-tartaric acids with bases. These salts are little known; like all vegetable acids, they are decomposable by fire; they cannot support an elevated temperature without being reduced to their elements. The pyro-tartrates of soda, ammonia, lime, barytes, and strontian, are very soluble; the first is even deliquescent, resembling much the acetate of potash, differing however in this respect, that the latter is not precipitated by the acetate of lead, while the pyro-tartrate of potash produces with it an abundant precipitate.

Q.

Quadroxalate of Potash. See *Acid Oxalate of Potash.*

Quicksilver. See *Mercury.*

Quinine. A muddy white substance, not crystalline, little soluble in boiling water, and still less so in cold water; it is soluble in alcohol and ether. Its vapour is that of the quinquina. The essential and volatile oils dissolve a small proportion of the quinine. Exposed to the action of heat it fuses at 194°; if the heat is continued, it decomposes like vegeto-animal substances; it undergoes no alteration by exposure to the air; it possesses alkaline properties, restores the blue colour of litmus paper when reddened by an acid; it saturates acids, producing white salts, which crystallize easily. Quinine exists in the yellow, red, and gray quinquinas, (peruvian bark,) combined with kinic acid. In the yellow quinquina this vegetable alkali exists in the greatest abundance.

Quinine was discovered by Pelletier and Caventon. It is obtained by decomposing with heat, the sulphate of quinine by magnesia; the quinine is deposited and remains mixed with an excess of magnesia; it is treated with alcohol, which dissolves all the quinine; this on cooling, is precipitated; it is purified by a second time dissolving in alcohol. According to the analysis of Pelletier, it is composed of carbon 75

Azote	8·45
Hydrogen	6·66
Oxygen.	10·43.

R.

Radical. That which is considered as constituting the distinguishing part of an acid by its union with the acidifying principle, or oxygen which is common to all acids; thus, sulphur is the radical of the sulphuric and sulphurous acids. It is sometimes called the base of the acid, but base is a term of more extensive application.

Rancidity. The change which oils undergo by exposure to the air.

The rancidity of oils is probably an effect analogous to the oxidation of metals. It essentially depends on the combination of oxygen with the extractive principle, which is naturally united with the oily principle. This inference is proved by attending to the process used to counteract or prevent the rancidity of oils.

Re-agent. (*Reactif.*) Synonymous with test. Such bodies are termed re-agents, as when brought in contact with other unknown bodies, form with them combinations, whose characters serve to point out the unknown body, or at least, to indicate its nature. All bodies, simple or compound, may be employed as re-agents; since all, when simple can form combinations, or when compound can be separated from their combinations to form new ones, when the sum of the forces which retain them, is less than the sum of the forces which tend to form new compounds. Although the term re-agent might thus be applied to all substances, its application is usually confined to such as are commonly used in chemical analyses. Many of these substances possessing analogous properties, produce singular effects with most of the substances to which they may be presented; we are to choose among these, that substance which has the greatest affinity for the substance sought for, or which forms with it combinations having the greatest cohesion. Other circumstances being equal, those re-agents should be selected, which are the cheapest, and may be most conveniently employed. These considerations reduce chemical re-agents to a comparatively small number. We shall, in this article, treat only of such as are most commonly used; those who wish for more extensive information, are referred to the Treatise on Re-agents (*Traité des Réactifs*) of MM. Chevalier and Payen. It is from this work that most of our remarks on the subject will be selected.

Acetate of copper (*acétate de cuivre*) precipitates gold from its solutions to a metallic state; it is also employed for ascertaining the quantity of sulphur contained in mineral waters.

Acetate of lead (*acétate de plomb*) forms with boracic acid a borate insoluble with water, soluble without effervescence in nitric acid, and fusible by the blow pipe into a colourless glass. It precipitates carbonates and subcarbonates white; the precipitate is heavy, soluble with effervescence in nitric acid. It also precipitates phosphates; the precipitates upon burning coals give an odour of phosphorus. Like the acetate of copper, it forms a sulphuret in solutions containing sulphur, and can of course be employed in the analysis of mineral waters. It precipitates almost all colouring matters. It serves to separate almost all vegetable acids which form an insoluble salt; it precipitates tartaric acid and does not precipitate hydro-tartaric acid. It is employed for ascertaining the purity of citric acid; if the precipitate contains no sulphate, it will dissolve in acetic acid. It detects foreign colouring matter in wines; such wines as are coloured by the elder and campeachy wood, it precipitates a deep blue; such as are coloured by sandal wood, or the red beet, it precipitates red; and precipitates greenish gray, such as are coloured naturally by the grape.

The *subacetate of lead* is employed in much the same circumstances as the neutral acetate. It precipitates the picromel from bile; it precipitates animal mucous matter in flakes, and does not precipitate gelatine.

Acetic acid is sometimes employed as a substitute for the acetate; it serves to neutralize certain salifiable bases, when it is wished to retain the salt in the liquid.

Arsenious acid, (*acide arsenieux*,) or the deutoxide of arsenic, precipitates sulphuretted hydrogen in a yellow sulphuret, giving an odour of garlic when thrown upon burning coals. It precipitates lime water; united with potash, it precipitates the solutions of copper green. All its precipitates when thrown upon hot coals give the same garlic-like odour.

Carbonic acid is employed for detecting the quantities of lime, barytes, and strontian, contained in liquors: an excess of this acid is introduced into the liquors to be examined, it is heated in order to precipitate the carbonate which is formed; these precipitates dissolve with effervescence in nitric acid. It precipitates white the sub-acetate of lead and the precipitate immediately becomes black by contact with an alkaline hydro-sulphuret.

Gallic acid colours the solution of iron; its colour is deep in proportion as the iron is more highly oxidated. It does not colour the solutions of the protoxides, unless in contact with the air at the same time; the acid employed should be in excess. It precipitates barytes greenish white; does not precipitate strontian. It precipitates the solutions of titanium orange red.

Hydriodic acid precipitates the solution of platina wire red.

Hydro-chloric (*muriatic*) *acid* precipitates silver from its solution in the state of a chloride insoluble in nitric acid, and soluble in ammonia. It precipitates the solutions of the proto-salts of mercury; and does not precipitate those of the deuto-salts, in which it forms a deuto-chloride (soluble corrosive sublimate). It discovers by white vapours the presence of free ammonia in any substance whatever; it is sufficient to present to this substance, a small tube or stick dipped in a solution of this acid, in order to perceive the loss of very small portions of ammonia through the lutes of an apparatus: by ammonia also, the loss of muriatic acid may be equally manifested. This acid is employed to separate iron from many metals upon which it does not act.

Sulphuretted hydrogen, (*hydro-sulphuric acid.*) is employed to ascertain the nature of metallic solutions by the colour of its precipitates; these precipitates are almost always sulphurets.

Thenard's Table of the colour of precipitates formed by sulphuretted hydrogen, in metallic solutions.

Salts of the first two sections . . .	*not precipitated*
manganese	*do.*
the protoxide and deutoxide of iron.	*do.*
peroxide of iron	*yellow.*
cerium	*not precipitated*
cobalt	*do.*
titanium	*do.*
nickel	*do.*
zinc	*white.*
deutoxide of tin (*d'etain deutox.*)	*yellow.*
protoxide of tin (*d'etain protox.*)	*chocolate.*
cadmium	*yellow.*
deutoxide of arsenic . .	*yellow.*
chromium	
molybdenum	
columbium	
antimony	*orange.*
uranium	
bismuth	*blackish brown.*
copper	*dark brown.*

Salts of tellurium	orange brown.
lead	blackish brown.
mercury	black.
silver (*d'argent.*)	black.
palladium	
rhodium	
platina	black.
gold (*d'or.*)	black.
iridium	

The nature of those precipitates which are of the same colour, is determined by other trials, and in these we are assisted by the knowledge that the metal must be one of those which give similar precipitates with the re-agent.

Nitric acid is frequently employed to separate the metals little oxidable from those which it can dissolve, in order to distinguish iron from steel; it forms upon the latter a black spot. It precipitates a concentrated solution of the arsenite and forms no precipitate in an equally concentrated solution of the arseniate. It entirely dissolves the deutoxide of mercury, but does not completely dissolve minium or the red oxide of lead, leaving a brown oxide more oxygenated than the former. It shows the presence of hydro-sulphuret, by precipitating the sulphur. It is employed in many of the chemical experiments upon minerals.

Oxalic acid has so great an affinity for lime that it takes it from sulphuric acid; it is therefore employed to detect this substance. It is employed pure or combined with ammonia; it is used to separate many metals mixed in solutions. Among these metals some form insoluble oxalates, and others soluble oxalates; as for example, in a mixture of iron, titanium, and cobalt, the oxalates of the last two are insoluble. It forms with barytes a soluble oxalate in an excess of the acid, which is not the case with strontian; when poured into wine which is adulterated with lead, it gives a precipitate which when heated by a blow pipe in the cavity of a piece of charcoal gives a globule of metallic lead.

Sulphuric acid precipitates the solutions of barytes, lead, and many other substances. The precipitate formed with solutions of lead gives with the blow pipe a metallic globule; that formed in solutions of barytes gives a yellow flame; that formed in solutions of strontian gives a purple flame. It dissolves indigo without discolouring it, but does not act in the same manner upon the cyanide of iron (prussian blue.) It points out most of the salts whose acids are volatile or little soluble.

Albumen (*albumine*) precipites in flakes the mercurial salts; the precipitate ought to give by combustion the mercurial vapour, which is easily known by the application of a plate of copper.

Alcohol. This re-agent is employed almost as frequently as water; its use is founded upon its property of dissolving certain bodies which are insoluble in water; and precipitating others by uniting with those which held them in solution; thus it is used in all vegetable analyses to separate the products, to dissolve resinous matters, and to separate certain salts; for example, the acetate of potash from the acetate of soda; the last is insoluble in alcohol.

Starch (*amidon*) shows the presence of iodine, with which it forms blue mixtures.

Ammonia (*ammoniaque*) precipitates copper from its solutions, and re-dissolves the precipitate, forming with it a blue liquor, which soon covers with metallic copper a plate of iron or zinc, that is dipped into it. It precipitates zinc white, redissolves the precipitate; it also precipitates iron but does not dissolve the precipitate when it is peroxidated. It is employed to separate iron from manganese; these metals being brought to the state of chlorides are treated by this re-agent, which dissolves the manganese while the iron remains in a solid state; it is however better as respects precision to separate the two metals by the succinate of ammonia.

Barytes (*baryte*). The water of barytes forms precipitates in many solutions, but is more particularly employed to ascertain the presence of sulphuric and carbonic acids; the precipitate formed by the first of these acids is insoluble in an excess of acid, very heavy and gives with the blow pipe in the cavity of a piece of charcoal a small fragment of the sulphuret of barium. The precipitate formed by carbonic acid is easily known by nitric acid.

Benzoate of ammonia forms an insoluble benzoate with the oxide of iron, and a soluble benzoate with those of manganese, nickel, and cobalt.

Borate of soda (*borate de soude*). Heated by the blow pipe with a metallic oxide it is coloured differently according to the nature of the oxide. It forms with the

Oxide of chrome	an emerald green.
cobalt	deep blue.
copper (*cuivre*)	bright green.
tin (*etain*)	pale green.
iron (*fer*)	bottle green or yellow.
manganese	violet.
silver (*argent*)	yellowish.
antimony	do.

The sub-borate of soda is always employed in the analyses of gases to separate sulphurous and muriatic acid, the latter of which it has the property of absorbing.

Carbonate of ammonia precipitates the solution of alumine, of glucina, and yttria, but an excess re-dissolves the last two bases without attacking the alumine.

Neutral carbonate of potash, when poured into a solution containing magnesia and lime, precipitates only the latter, if the solution is cold.

Sub-carbonate of potash is chiefly employed with the sub-carbonate of soda to precipitate metals from their solutions.

e of the precipitates of different metallic solutions
oduced by the sub-carbonates of potash and soda:

tions of alumine . .	white flakes.
silver (*argent*)	white, it blackens by the action of light and sulphuretted hydrogen.
barytes . . .	white, pulverulent, soluble in nitric acid.
bismuth . .	white, blackens by sulphuretted hydrogen.
cerium . . .	granulate, of a silver whiteness.
lime (*chaux*) .	white.
cobalt . . .	violet.
copper (*cuivre*)	apple green.
iron (*fer*) . .	yellow or brown.
glucina . . .	white.
yttria . . .	white, pulverulent.
manganese .	reddish white.
magnesia . .	white, light, flosculous.
lead	white, heavy, blackens by contact with sulphuretted hydrogen.
strontian . .	white, heavy.
titanium . .	yellowish white.
uranium . .	white.
zinc	white.
zirconium . .	white.

leat (*chaleur*) or *caloric* is much employed in chemi. analyses. When a mixture contains two substances of ch one at a certain degree of heat is volatile and the er fixed, it is evident that it will be sufficient, in order separate the constituent principles, to raise the tem. ature of the mixture to that degree which is necessary olatilize the one. In other cases heat renders solu. in certain mediums substances which are insoluble in same medium without this agent, and which can be arated on the cooling of the liquid. The various ways vhich bodies are affected by caloric as to their fusion, change of colour, diffusion of odours, volatilization, colour of their vapour, decomposition, &c., often throw great light upon their nature, and sometimes are alone sufficient to manifest their presence.

Chlorine (*chlore*) precipitates solutions of those hydrogenated bodies, in which hydrogen is united to a substance by itself insoluble in the liquid of the solution; it is the same as respects the gases with gaseous chlorine. It decomposes most vegetable and animal substances, particularly colouring matter, always by uniting with their hydrogen. It precipitates solutions of silver white; the precipitate which is insoluble in nitric acid and soluble in ammonia, is a chloride.

Chromate of potash (*chrômate de potasse*) precipitates the solutions of lead yellow or orange, those of mercury red, and those of silver purple.

Cyanide of mercury (*cyanure de mercure*). Its solution precipitates the solutions of palladium yellow.

Distilled water is one of the substances most used in analysis. It serves to dissolve and to separate soluble bodies from those that are not soluble; it is used for diluting solutions, to collect substances which adhere to the apparatus, filters, &c. *Lime water* (*eau de chaux*) demonstrates by a white precipitate the presence of carbonic acid in a liquid; by a yellow, orange, or brick coloured precipitate it shews the presence of the perchloride of mercury (*corrosive sublimate.*) It precipitates white, phosphates, oxalic acid, and the oxalates; the appearance of the precipitate, and the manner in which it acts with caloric, serve to distinguish it.

Ether, like distilled water and alcohol, has the property of dissolving many bodies, and is particularly employed in vegetable analyses in order to separate the different principles; it dissolves wax, resin, and many other substances.

Gelatine precipitates tannin from its solutions; the precipitate is flaky, and collects in an elastic mass; it also precipitates many metallic solutions.

TABLE

Of the precipitates produced by gelatine in some metallic solutions. (According to MM. Payen and Chevalier.)

Muriate of gold, (*hydro-chlorate d'or,*) a yellowish precipitate, abundant, soluble by an addition of water.
Nitrate of silver, a milky precipitate.
Nitrate of mercury, cheesy precipitate.
Per-chloride of mercury, white precipitate.
Proto-sulphate of iron, yellow flakes.
Per-sulphate of iron, milky precipitate.

Hydriodate of potash, or *iodide of potassium,* (*iodure de potassium,*) precipitates the solution of lead a brilliant yellow, those of the peroxide of mercury red, those of bismuth a chestnut-brown, and those of silver yellowish white; these precipitates are iodides; that of silver is not soluble in ammonia as most other combinations of silver are.

Muriate de barytes (*chlorure de barium*) is employed, like the nitrate of barytes, to demonstrate the presence of sulphuric acid.

Muriate of strontian, or *chloride of strontian,* forms a precipitate with sulphuric acid, and a soluble salt with boracic acid; it serves to separate these two acids.

Muriate of potash, or *chloride of potassium,* (*chlorure de potassium,*) forms in the solution of tartaric acid a precipitate of cream of tartar; it does not form a precipitate with citric acid; it is the same with the sub-carbonate of potash.

Muriate of tin, or *chloride of tin,* (*chlorure d'etain,*) precipitates blue, solutions which contain molybdic acid; orange-yellow, solution of platina; deep brown, those of the per-chloride of mercury and the neutral solutions of palladium; it forms with tannin a dirty white precipitate.

Muriate of gold, or *chloride of gold,* (*chlorure d'or,*) precipitates brown the solutions of the proto-sulphate of iron, also forms a precipitate with the essential oils.

Muriate of platina, or *chloride of platina*, (*chlorure de platine*,) precipitates yellow the neutral salts of potash, and does not precipitate the neutral salts of soda.

Cyanide of potassium (*cyanure de potassium*) is frequently employed as a re-agent, and the ferro-cyanide of the same metal still more so, in order to ascertain the nature of metals contained in solutions; they form in these solutions precipitates differently coloured.

TABLE

Of the colours of precipitates produced by the cyanides and ferro-cyanides of potassium in different metallic solutions.

Saline solutions of	Colours of the precipitates by the *ferro-cyanide of potassium.*	Colours of the precipitates produced by the simple *cyanide of potassium.*
Zirconium,	white or clear yellow.	
Manganese,	white,	dirty yellow.
Protoxide of iron,	white, abundant,	orange, abundant.
Deutoxide of iron,	sky-blue, abundant,	bluish green, abundant
Tritoxide of iron,	deep blue, abundant,	almost insensible.
Tin,	white,	white.
Zinc,	white,	white.
Cadmium,	white,	white.
Antimony,	white,	white.
Uranium,	blood-red,	yellowish white.
Cerium,	white.	
Cobalt,	grass-green.	
Titanium,	brownish red.	
Bismuth,	white,	white.
Protoxide of copper,	white,	white.
Deutoxide of copper,	crimson,	yellow.
Nickel,	apple-green,	yellowish white.
Lead,	white.	
Deutoxide of mercury,	white,	yellow.
Silver,	white becomes blue by the air.	white, soluble in an excess of the cyanide.
Palladium,	olive-green,	
Platina.		
Rhodium.		
Gold,	white,	white at first, becomes a beautiful yellow.

Hydrogen (*hydrogène*) is employed in the analysis of gases, in order to burn the oxygen which they contain, and to determine the quantity.

Iodine (*iode*) serves to show the presence of starch, with which it forms blue compounds.

Metals possess a peculiar brilliancy and a property of easily becoming oxidated; chemists avail themselves of these properties in investigating the nature of substances. The existence of sulphuretted hydrogen with metals is detected principally with silver; upon a plate of copper may be discovered the presence of mercury, silver, and of many other metals; these are afterwards examined with new re-agents; with a plate of copper may be ascertained the presence of iron, zinc, gold, &c. It is often sufficient to rub upon a clear metallic plate a precipitate which has been obtained in order to ascertain its nature by the traces which it leaves upon the metal. Two metals, as zinc and copper brought in contact, constitute the voltaic pile, or galvanic battery, which disunites the elements of bodies having great cohesion, or whose elements have so strong an affinity as to oppose a separation by any other chemical means.

Nitrate of silver (*nitrate d'argent*) forms a chloride of silver, white, heavy, and curdled, in all solutions which contain chlorine, hydrochloric acid, or chlorides. This precipitate is insoluble in nitric acid and soluble in ammonia. It forms a yellow sub-phosphate of silver in solutions which contain phosphoric acid and in the phosphates. This phosphate gives, with the blow pipe, an odour of garlic or phosphorus. The nitrate of silver gives also a fine yellow colour to liquors which contain the oxide of arsenic; but it is very difficult when the liquor contains little arsenic, to collect the precipitate which gives with the blow pipe the garlic smell observed in the phosphates. It colours black, liquors which contain traces of sulphuretted hydrogen.

Nitrate of barytes is particularly employed to demonstrate the presence of sulphuric acid and the sulphates. *Nitrate of mercury* (*proto*) forms with ammonia a gray precipitate which heated with a little lime disengages ammoniacal vapours. *Nitrate of potash*, or *saltpetre* is employed for the separation of arsenic from its combinations. It is melted with the substance containing arsenic; the whole is dissolved in water and may be precipitated by the nitrate of silver, the sulphate of copper, sulphuretted hydrogen, &c. *Nutgalls* (*noix de galle*); an infusion of these is chiefly employed to ascertain the presence of iron, solutions of which it colours bluish black, more intense in proportion as the metal is more oxidated. When in the state of a protoxide the colour is visible only by agitating it in the air. This infusion precipitates solutions of osmium a dark blue; it precipitates those of titanium orange yellow; those of silver white; those of mercury orange; and those of uranium brown.

Papers without sizing, and impregnated with different re-agents whose colour changes by various solutions into which they may be dipped, serve to indicate the nature of these solutions; of this kind are *litmus paper*, *curcuma paper*, and papers impregnated with the acetate of lead, the nitrate of silver, &c. *Per-chloride of mercury*, or corrosive sublimate, precipitates lime water yellow and ammonia white; it forms with albumen a flaky precipitate, especially if the liquor is heated. *Picromel* precipitates white the sub-acetate of lead, but does not precipitate the neutral acetate.

Potash. The aqueous solution when pure, at the temperature of boiling water, dissolves alumine to jelly and does not dissolve the oxide of iron; it forms in metallic solutions precipitates of hydrated oxides, differently coloured; it redissolves some when it is used in excess.

TABLE

Of the colour of Precipitates formed by pure Potash in metallic solutions. (According to MM. Chevalier and Payen.)

Solution of Zirconium, . . .	grayish white.
Aluminum, . . .	white, half transparent.
Magnesium, . .	white.
Nickel, ...	apple green.
Protoxide of iron, .	green.
Peroxide of iron, .	red.
Gold, ...	reddish.
Uranium, . . .	yellowish green.
Manganese, . . .	reddish white.
Bismuth, . . .	white.
Cobalt, ...	greenish white.
Protoxide of mercury,	black.
Deutoxide of mercury,	yellow.

Succinate of ammonia serves to separate iron from manganese; when poured into a solution containing these two metals, and when the iron is peroxidated, it forms a succinate of iron which precipitates. An excess of the succinate must be avoided.

Sulphate of copper, (*sulfate de cuivre,*) forms with the arsenites a green precipitate, and with arseniates a bluish white precipitate.

Proto-sulphate of iron precipitates gold from its solutions.

Per-sulphate of iron precipitates blue, hydro-cyanic (prussic) acid and the soluble cyanides; and black, the solutions which contain gallic acid.

Sulphate of soda forms in solutions of lead a white precipitate, which dried and heated by the blow-pipe in the cavity of a piece of charcoal, gives a metallic globule. *Tannin* precipitates gelatine and albumen.

Infusions or tinctures are very useful as chemical tests; the principal kinds are as follows: *litmus* or *turnsol* is reddened by an acid, and its purple hue may be restored by an alkali; but it is less active than other direct alkaline tests. *Red cabbages* and *radishes* furnish as delicate tests for acids as litmus, and still more so with respect to alkalies. *Brazil wood* gives a red infusion which turns blue by alkalies and yellow by acids. *Blue violets* afford a delicate test for the presence of alkalies and acids; sirup of violets, being an article used in medicine, is sometimes more conveniently obtained, but the simple tincture answers equally well. *Turmeric* or *curcuma* is a very delicate test for alkalies; its natural colour is yellow, it is turned to an orange red by alkalies.

In concluding the subject of re-agents it should be remarked, that it would not be proper to pronounce upon the nature of a body, for example, of a pure metal, by the colour of the precipitate, when only one re-agent had been employed; it is necessary to repeat experiments, and not to decide upon the nature of substances till they have been tested in various ways. A profound knowledge of chemistry, and especially much practice is necessary, before analyses can be performed to any advantage.

Realgar. A name formerly given to the red sulphuret of arsenic.

Receiver. Receivers are chemical vessels which are adapted to the necks or beaks of retorts, alembics, and other distillatory vessels, to collect, receive, and contain the products of distillation.

Reduction, or Revivification. This word in its most extensive sense, is applicable to all operations by which any substance is restored to its natural state, or what is considered as such; but custom confines it to operations by which metals are restored to their metallic state after they have been deprived of it, either by combustion, as the metallic oxides, or by the union of some heterogeneous matters which disguise them, as fulminatng gold, luna cornea, cinnabar, and other compounds of he same kind. These reductions are also called revivifications.

Regulus. Diminutive of *rex* a king, so called because he alchemists expected to find gold, the king of metals, collected at the bottom of the crucible after fusion. The alchemists gave, in general, the name of regulus to metallic oxides reduced by means of fusion, because they expected to find gold in the metallic products which they obtained. The chemists who succeeded them continued to call thus their *demi-metals*, such as antimony, arsenic, cobalt, &c.

Resin. (*Résine.*) A solid inodorous substance, brittle, semi-transparent, and heavier than water. The resins all become negatively electrified on rubbing; none are conductors of electricity. Exposed to the action of fire, they burn with a yellow flame and much smoke. Water does not dissolve the resins; they dissolve very well in alcohol, ether, the essential and fixed oils, and the waters of potash and soda. All the resins are unalterable by the air; concentrated acetic and hydro-chloric acids dissolve without decomposing them; they can be precipitated by diluting the water of the solution.

It is different with sulphuric and nitric acids; the first easily dissolves the resins, though at the ordinary temperature they are little altered; the solution is viscous and transparent, and by the addition of water it immediately precipitates a resinous matter; but if the solution is heated it becomes brown, disengages much sulphurous gas, forms water, and deposites charcoal. If, before becoming entirely black, it is diluted with water and the precipitate treated with alcohol, artificial tannin is produced. Nitric acid decomposes the resins with violence, much gas is disengaged; the solution is not affected by water, and gives by evaporation a residue which may be entirely changed to artificial tannin by treating it a second time with nitric acid.

The resins are a vegetable product; they exude from trees, through pores or incisions which are made to facilitate their discharge. They are generally united to essential oils, which give them their peculiar taste, and render them soft. Some are even fluid at the ordinary temperature, as turpentine, &c.; others are solid and odorous, as the mastic, animated resin, &c.

The resins are formed of a great proportion of carbon, hydrogen, and a small quantity of oxygen; none contain nitrogen. Gay-Lussac and Thenard found in 100 parts of the resin of the pine,

Carbon, . .	75·944,
Hydrogen, .	10·719,
Oxygen, . .	13·337.

Retort. A distilling vessel, having for its neck a long bent cylinder; from its crooked form its name, retort, has been probably given. The upper part of the retort is called the *vault*, the cylindrical part the *neck*. Some retorts have an aperture at the vault closed with a glass stopper, such are called *tubulated* retorts.

Retorts are of crystal, glass, platina, silver, iron, lead, porcelain and stone.

Rheine. Of a yellowish orange colour, without any peculiar smell; its taste is slightly bitter, and it is soluble in ether and alcohol. It was first observed by Vaudin.

Rhodium. A solid metal, brittle, of a grayish white, without action upon oxygen gas at any temperature; specific gravity is 11·000. It does not dissolve in any acid, but may be oxidated by strongly calcining it in a crucible with the nitrate of potash. It has been combined with sulphur and some metals. It has only been discovered in the ore of platina, and then in very small quantities.

Rhubarbarin. A name employed to denote the active principle of rhubarb.

Rochelle Salt. *Tartrate of potash.*

Rust. *Red oxide of iron.*

S.

Saccho Lactates. A name formerly given to the mucates. See this word.

Safety Lamp (Davy's.) See *Hydrogen.*

Saffron of Mars (Aperitive.) Ancient name for the carbonate of iron.

Saffron of Metals. Preparation of antimony. See *Crocus Metallorum.*

Sal Alembroth. *Salt of wisdom.* A white, very volatile salt, obtained by subliming a mixture of equal parts of the deuto-chloride of mercury and the muriate of ammonia.

Sal Ammoniac. *Muriate of ammonia.* So called because it was found near the temple of Jupiter Ammon.

Sal Ammoniac of Glauber. Sulphate of ammonia.

Sal Glauberi. Sulphate of soda, or Glauber's salts.

Sal Gemme. Native muriate of soda.

Sal Martis. *Salt of mars.* Green sulphate of iron.

Sal Plantarum. *Salt of plants.* Sub-carbonate of potash.

Sal Saturni. *Salt of Saturn.* Acetate of lead.

Sal Tartari. *Salt of tartar.* Tartaric acid.

Sal Vegetabilis. *Salt of vegetables.* Tartrate of potash.

Sal Volatile. *Volatile salt.* Aromatic spirit of ammonia.

Salifiable. Having the property of forming a salt. The alkalies, and those earths, and metallic oxides, which have the power of neutralizing entirely, or in part, and producing salts, are called salifiable bases.

SALINE. (From *sal*, salt.) Of a salt nature.

SALTPETRE. Nitrate of potash. (See this word.)

SALTS. (*Sels*. In Latin, *Sal*.) Salts are the result of the combination of acids with salifiable bases. The ancients understood the word *salt* in a very limited sense; as including only such crystalline substances which, like common salt, (chloride of sodium,) were more or less sapid and of course soluble in water. Chemists at present comprehend under the name of salts the immense number of combinations which can take place between all the acids and all the metallic oxides; as between ammonia and vegetable salifiable bases. As there are certain oxides which sometimes perform the part of an acid, sometimes that of an oxide; and as this case is very common in the natural combinations which oxides form among themselves, it follows that in certain salts we regard as acid the principle which goes to the positive pole of the voltaic pile; thus the oxides of gold form salts with some acids and combine equally with potash, with which they perform the part of an acid, forming saline compounds called *orates*.

The formation of salts is in general easy in proportion to the degree of affinity which the metal of the oxide has for oxygen: now the oxide in a protoxide being retained more strongly than that in a tritoxide or a deutoxide, it follows that the protoxides unite to acids more easily than the oxides which are more highly oxidated.

Salts may exist with excess of base, with excess of acid, or they may be composed in such a proportion that the quantity of the acid completely neutralizes the quantity of the base; the last are called neutral salts, the second acid salts, and the first sub-salts. (See *Nomenclature Chemical*.) A salt is commonly considered as neutral when it has no action upon vegetable colours: but this rule is not general, as whenever the acid of a salt has little affinity for the base, the salt, although neutral, is seldom without action upon colours. It cannot then be affirmed that a salt is neutral until its composition is known.

The salts have been divided into *genera* and *species*; in attempting to study them without order, we should become confused in their great variety of characters and properties. Many useful classifications of these substances have been made. Fourcroy divides the salts into genera according to the *acids* which compose them; thus he named *sulphates* (*sulfates*) all the combinations of sulphur with salifiable bases, &c.; he designated the species by adding to the name of the genus the name of the base with which the salt was formed; thus he gave the name *sulphate of iron* (*sulfate de fer*) to the combination of sulphuric acid with the oxide of iron. Thomson on the contrary took for the *genera* the name of the *base*, and for the *species* the name of the *acid*; thus instead of the term sulphate of iron he used *iron sulphated*. This last classification has been rejected except in mineralogy; and perhaps even here ought to be abandoned on account of the analogous crystallographical characters presented by each series of salts containing the same acid.

One of the principal reasons for preferring Fourcroy's classification is the composition of the salts which are formed by the same acid. All the salts of the same genera, at the same point of saturation, contain such proportions of the acid and the oxide that the quantity of oxygen and of the oxide is in proportion to the quantity of the acid, and often to the quantity of the oxygen of the acid. As a result of this law, the quantities of the salifiable base which unite to an acid to form one genus of salts are in the same proportion as those which unite to another acid to form another genus of salts; of course in mixing two neutral salts capable of being decomposed, the result is new salts, which are also neutral.

Thus the composition of a salt of any particular genus being known, it becomes easy to calculate the composition of all the other salts of this genus by knowing the composition of their oxides; and if the quantity of acid and oxide which constitute a salt are known, it is easy to calculate the quantity of oxygen contained in that quantity of oxide. It is in this way that chemists are able to judge of the composition of the oxides of magnesium, of zirconium, of aluminum, &c., although they have never been able to obtain their metals. It is according to these laws and the knowledge of the composition of a salt, that a decision can be made with respect to its being neutral, although it reddens litmus or greens the infusion of violets. The physical characters of the salts are very variable, and their chemical characters are not less so: some general properties may however be pointed out.

If salts are exposed to the action of *caloric*, whose acids are not volatile, and which have much affinity for the bases, they experience no alteration; most of the others are decomposed; many volatilize; almost all melt at first in their water of crystallization, and afterwards experience the igneous fusion. If exposed to the air, some attract moisture and liquefy; others, on the contrary, part with their water of crystallization and become efflorescent; the greatest part experience no alteration.

In considering the action of *water* upon salts, they might be divided into two grand divisions, viz., *soluble* and *insoluble;* but it would be impossible to define their boundaries; indeed, strictly speaking, few salts are absolutely insoluble, since all are more soluble in hot than in cold water, and many can be crystallized on cooling. Water which is saturated with one salt can still dissolve others, but in a smaller quantity; this property has been applied to the purification of some salts. All the salts based upon potash, soda, and ammonia, are soluble in water. It is the same with all the acid salts, except in a few cases; as the tartrates, which, being soluble in the neutral, are less so in the acid state. Their solubility depends much on their cohesion, which often neutralizes in a degree their affinity for water.

If into a saline solution is plunged a *metal* which has more affinity for oxygen than the metal which the salt contains, there will be a decomposition, and the latter metal will be substituted for the other, which will be deposited on its surface. By the contact of the two metals is thus formed an element of the voltaic pile, which accelerates the decomposition.

Acids often decompose salts to unite with their bases; the other acid is then left free; this action will take place at the ordinary temperature if the acid employed is much stronger than the salt. At an elevated temperature a decomposition will always take place whenever the acid employed is undecomposable and not volatile at that temperature, while the acid of the salt employed possesses opposite qualities; that is, when it may at a high temperature be decomposed or volatilized. If an hydracid is employed and decomposition takes place, the salt will not only be decomposed, but the acid employed, and the oxide of the salt will also be decomposed, producing water, a chloride, iodide, &c., according as hydro-chloric, hydriodic acids, &c., have been employed.

When into a saline solution is poured a solution of *another salt*, and an insoluble salt is formed, the decomposition takes place immediately; but if the two salts are soluble, the decomposition does not take place; or at least is not apparent until the liquor is evaporated. Then the less soluble salt will first form and crystallize; but during the course of the operation it may happen that another salt will be deposited, whose crystallization would require a different temperature, and thus salts of a different kind would be obtained. Certain insoluble salts may also be decomposed by soluble salts, but the result will always be an insoluble salt. The action will continue until the degree of saturation of the liquids is in equilibrium with the force of cohesion of the insoluble salt; of course this decomposition does not depend upon the general laws of composition, which govern the soluble salts.

There are in nature many salts; the insoluble are most abundant: sometimes they are deposited in extensive beds, as the sulphate of lime, (*gypsum*); sometimes they form whole mountains, as limestone, (*carbonate of lime*,) phosphate of lime, &c.: sometimes they are found in veins, as the sulphate of barytes, phosphate of lead, carbonate of copper, &c. Such as are soluble are found in an efflorescent state, as alum, the nitrate of potash, (saltpetre,) and carbonate of soda; or in solution in water, as the sulphate of soda, magnesia, iron, copper, &c. Salts are obtained by various processes; the four following are the principal:

1st. By combining directly with acids, oxides, or the sub-carbonates; when sub-carbonates are employed, there is usually an effervescence and disengagement of caloric. 2d. By treating metals with acids; it is necessary to employ acids so diluted that the salt can dissolve as fast as it forms. 3d. When they are insoluble, they are obtained by double decomposition. 4th. When they are sub-salts, as they are usually insoluble, they may be procured by carefully pouring into the solution of a neutral salt a small quantity of potash or soda.

SALTS ACID. Salts, with excess of acid. See *Salts.*

SALTS DOUBLE. The double salts generally result from the union of two bases with an acid; these were formerly called triple salts. All the salts possess the power of uniting to form double salts; but those which tend more especially to this are the ammoniacal salts; next those based upon potash and soda. Almost all the double salts contain one of these three bases; they are usually less soluble than the salts which constitute them; and the quantities of oxygen of the two bases are always in simple ratio between them.

Salt Common. (*Sel Gemme*, French. *Sal Gemma*, Latin.) The chemical name for common salt was formerly *muriate of soda*. After the discovery of chlorine, it was termed the *hydro-chlorate of soda;* but since, potash, soda, &c., by the discovery of Sir H. Davy, are found to contain a metallic base, we must again change the name of common salt to that of *chloride of sodium*. (*chlorure de sodium*). This substance is found in masses in the bosom of the earth, and then called *rock salt*. Its colours are sometimes very brilliant, owing to the various substances with which it is found combined; it is always transparent, and received its ancient name of *gem*, on account of its resemblance to precious stones. It is usually found associated with sulphate of lime and argillite. It is sometimes obtained from mines in a pure state; when mixed with any foreign substance, it is purified by being placed in pits, and saturated with water; the water is then drawn out by means of a pump, and evaporated. Much of the salt of commerce is obtained from the evaporation of natural waters, which contain the chloride of soda in solution.

Salts of Epsom. *Sulphate of magnesia.* In commerce this name is often falsely applied to the sulphate of soda whose crystallization has been disturbed. It is easy to distinguish them, by pouring into their solution, a small quantity of potash or soda, which produces no action in the true Epsom salts.

Salt of Lemons. Super-oxalate of potash.

Salt Marine. See *Salts*. Chloride of sodium.

Salt of Nitre. *Salt-petre.* Nitrate of potash.

SALT of OPIUM. Narcotine.

SALTS of ROCHELLE. *Rochelle salts.* Tartrate of potash and soda.

SALT of SODA. (*Sel de Soude.*) Sub-carbonate of soda.

SALT of SORREL. Acid oxalate of potash.

SALT of TARTAR. Name given to the sub-carbonate of potash, and sometimes to the acid tartrate of potash.

SANTALINE. The colouring matter of the red sandal wood. This wood is obtained in the East Indies, and in some of the South sea islands; it is the product of a plant whose generic name is *Santalum*, derived from the Arabic wood *zandal*; in French the word is called *santal*; in Enlish, *sandal*, and sometimes *saunders* wood. According to Pelletier, this is a red solid substance; it fuses when exposed to a heat of more than 212°, decomposing like resins, to which in many respects, it bears a resemblance. It scarcely dissolves in water, but is very soluble in alcohol, ether, acetic acid, solutions of potash, soda, and ammonia. Chlorine discolours it, and converts it into a yellow matter, which retains muriatic acid. Sulphuric acid chars it. Most of the salts poured into alcoholic solution, produce coloured precipitates. Santaline is obtained by treating successively powdered red sandal wood, with boiling alcohol; on evaporating the alcohol, the santaline is obtained pure.

SAPONIFICATION. (From *Sapo*, soap.) Our article on this subject will be extracted chiefly from the researches of Chevreul, into the nature of fat substances; until the investigation of this laborious and learned chemist, very little was known upon the subject. By the term saponification is to be understood the changes which fat substances experience in their equilibriums, by the action of an alkali. This equilibrium being destroyed, the elements of these substances combine in other proportions, giving rise to acids which combine with the adjacent alkalies, and form real salts. There is also the formation of a peculiar substance, not acid, called *glycerine.* (See this word.)

Two principal causes thus concur to produce saponification. 1st. The influence of an alkali. 2d. The nature of a fat substance, of which the one of its elements, having a strong affinity for salifiable bases, shall constitute as much as half the fat substance. It may be easily conceived that fat substances exist which do not contain sufficient oxygen to permit the formation of an acid, and therefore, that with them the process of saponification cannot take place; this is the case with cholesterine. Fat substances then will saponify better in proportion as their compounds contain acid principles. This may be observed in stearine, elaine, (*oléine,*) phocenine, and butyrine, in which acids constitute at least 92 parts in 100, while glycerine makes up the remainder of the mass. Potash, soda, barytes, strontian, lime, and the yellow oxide of lead, convert the fat of pork into stearic, margaritic, and oleic acids, and glycerine.

It is remarkable that the oxides of zinc and lead, which are insoluble in water, and give rise to compounds equally insoluble, produce the same results as potash and soda, which proves that they have a very strong alkaline power. In considering saponification in a general manner, it will be seen that the preparation of plaster with litharge is a real process of saponification. It is remarkable that magnesia, which exhibits in most respects strong alkaline properties, seems to change grease into soap, with much more difficulty than the oxides of lead and zinc, which appear much less alkaline than this salifiable base; but if magnesia saponifies grease very slowly, it presents before completing the saponification, the phenomenon of a base, which contracts with a fat not acid, such a union as to give rise to a homogenious compound, from which the fat cannot be insulated even on exposure to boiling water, although in this circumstance two causes tend to produce a separation; 1st, the difference of density; 2d, the facility with which magnesia in a pure state imbibes water. Alumine adheres to the grease less closely; it is separated by boiling water.

The salifiable bases have then three ways of acting upon grease: 1st, they convert it into glycerine, stearic, margaritic, and oleic acids; such are potash, soda, barytes, strontian, lime, the oxides of lead and zinc, magnesia, and ammonia, the last two act very slowly; 2d, they contract a union, or rather an adhesion, with grease, without its undergoing any change, as has been observed with respect to magnesia before saponification; 3d, they form no sensible union; such are the bases which, having been carefully mixed with grease, separate when the mixture is put into boiling water. (Chevreul's Researches into the nature of fat substances.)

SATURATION. A substance is said to be saturated with another substance when it will dissolve no more of it. The degree of saturation varies by caloric which separates the molecules, and pressure which brings them nearer. Thus water which would be saturated by any particular salt at the common temperature, would not be so at a more elevated temperature, because the molecules being thus separated would admit those of the salt to pass in between them. The capacity of saturation then increases in proportion as the substance is heated. There are a few solid bodies which form an exception to this rule. Common salt (chloride of sodium) does not sensibly dissolve in a greater quantity of hot than cold water; lime is precipitated by heating water with which it is saturated. Pressure produces in solid bodies an inverse effect to that of caloric, but in the gases it increases the capacity of saturation. Thus water, which at the ordinary temperature and under the ordinary pressure, would be saturated by a volume of gas equal to its own, would be able by a strong pressure or by lowering the temperature (if it did not congeal) to dissolve a much greater quantity of gas, and to contain 2, 3, 4, 5, or more times, its volume. See *Attraction*.

Saturn. A name given by the ancient chemists to lead, in allusion to Saturn, who devoured his children, because lead combines with various metals, or devours them.

Savons. See *Soaps*.

Savonule. (*Saponule.*) A name given to combinations of the essential oils with salifiable bases; these combinations have been little studied; they are very feeble and cannot take place but with the most energetic salifiable bases.

Sebates. They are little known. Those of potash, soda, and ammonia, are soluble. Their solution is decomposed by most strong acids, which precipitate the sebacic acid. The sebates of lead, mercury, silver, and probably of most other metals, are not soluble in water.

Seleniates. According to Berzelius, it appears that selenic acid can combine in four proportions with salifiable bases, forming *neutral seleniates*, *acidulated seleniates*, *acid seleniates*, and *seleniates with an excess of base*. In the neutral seleniates the quantity of the oxygen of the oxide is to the quantity of the oxygen of the acid in the proportion of 1 to 2, and to the quantity of acid as 1 to 6·959. The acidulated seleniates, or bi-seleniates, contain twice as much acid; the acid seleniates, or quadri-seleniates, contain 4 times as much acid as the neutral seleniates. The composition of the sub-seleniates is not known.

The seleniates are not decomposed by the action of fire, except when heated with a combustible body. The different combinations of selenic acid with potash, soda, and ammonia, are soluble in water; the other seleniates are not soluble, but become so by an excess of acid. Sulphuric acid, at the ordinary temperature, decomposes the seleniates; arsenic, boracic, and phosphoric acids decompose them only with the aid of heat; these are the only acids which have been found capable of effecting their decomposition. The seleniates of potash, soda, and ammonia are prepared directly; all the other neutral seleniates are obtained by double decomposition. The acidulated and acid seleniates are obtained by combining directly a new proportion of selenic acid with the neutral seleniates.

Selenite. Native sulphate of lime. (See this word.)

Selenium was discovered by Berzelius and by him regarded as a metal; metals do indeed exist in nature, such as arsenic and tungsten, of which there are no salts, and which can on the contrary form acids like the combustible non-metallic bodies; but selenium, joining to these properties those of being a very bad conductor of caloric and electricity, we shall consider it as a non-metallic substance. It is solid, insipid, inodorous, very brittle; its specific gravity is 4·31. If exposed to a temperature of 224°, it fuses, and at a higher temperature volatilizes. Its vapour is deep yellow. If instead of allowing it to volatilize it is cooled quickly, it presents a brown mass, possessing a brilliancy and a glassy brittleness. Its vapour suddenly cooled produces a red powder resembling, except in colour, the flowers of sulphur.

Selenium can combine with oxygen in two proportions forming an oxide and an acid; it also combines with hydrogen, producing hydro-selenic acid. It forms compounds with sulphur, phosphorus, and most of the metals. Selenium has yet been found only in seleniuretted copper, and the cupreous seleniuret of silver, minerals which have been found but in two localities. That obtained by Berzelius was from the seleniuretted copper which exists in the pyrites of Falhun.

Seleniurets (*Séléniures.*) Compounds having a great analogy with sulphurets; in their composition they are equally regulated by fixed laws; thus the quantity of the oxygen of a protoxide is to the quantity of selenium of a proto-seleniuret, in the proportion of 1 to 4·854. Like the sulphurets, they are prepared directly, by introducing into metallic solutions, a current of hydro-selenic acid. We shall, with Berzelius, consider as seleniurets the compounds which result from the action of hydro-selenic acid with salifiable bases. See *Sulphurets.*

SELENIURET of ANTIMONY (*Séléniure d'Antimoine.*) This, like the sulphuret of the same metal, is very fusible; when heated in the air, a transparent, vitreous scoria rises to the surface; this seems analogous to the glass of antimony. Treated with hydro-chloric acid, it produces a chloride of antimony and hydro-selenic acid. It is obtained directly.

SELENIURET of ARSENIC (*Séléniure d'Arsenic.*) Black, very fusible; it is obtained by gradually adding powdered arsenic to melted selenium. Combination immediately commences; and by a careful heat, either of the two bodies which may be in excess, is expelled. If the heat is raised to redness, the seleniuret boils, and produces the per-seleniuret of arsenic; there remains in the vessel a liquid which cannot be volatilized but at a very high temperature.

SELENIURET of COPPER. (*Séléniure de Cuivre.*) The deuto-seleniuret of copper is obtained by passing a current of hydro-selenic acid into a solution of the deuto-sulphate of copper: it is precipitated in abundant black flakes.

SELENIURET of IRON. (*Séléniure de Fer.*) of a yellowish gray colour, hard, brittle, and granular; hydro-chloric acid decomposes it, forming a proto-chloride of iron and hydro-selenic acids, a small portion of which is decomposed and colours the liquid red.

This seleniuret, which like the sulphuret, possesses a metallic lustre, which is obtained by heating in a glass tube selenium covered with iron filings; light is disengaged during the combination.

Seleniuret of Mercury. (*Séléniure de Mercure.*) Is obtained by heating a mixture of mercury and selenium; the body which is in excess volatilizes. If the temperature is a little more elevated, the seleniuret itself volatilizes and condenses in white scales in the upper part of the vessel.

Seleniuret of Platina. (*Séléniure de Platine.*) Platina is one of the metals for which selenium has the greatest affinity; thus the combination takes place at a low temperature; notwithstanding this affinity, this seleniuret is decomposed at red heat when in contact with the air.

Seleniuret of Lead (*Séléniure de Plomb.*) Gray, porous, susceptible of polish by rubbing, does not fuse easily. Heated in oxygen gas, it absorbs it and produces a seleniate of lead. It is obtained directly.

Seleniuret of Potassium. (*Séléniure de Potassium.*) Of an iron gray colour, with a metallic lustre. Its fracture is radiated, and exhibits the rudiments of crystals. It is soluble in water, and presents the same properties as the sulphuret of potassium. It is obtained directly, with a disengagement of light and caloric.

Seleniuret of Zinc. (*Séléniure de Zinc.*) Yellow, pulverulent; it is obtained by bringing the vapour of selenium in contact with zinc; heated to redness; there is always an explosion; the seleniuret which is formed is in a very small proportion.

Seleniuretted Hydrogen. See *Acid Hydro-Selenic.*

Septone. One of the ancient names for azote or nitrogen.

Serum (From *serus*, late, because it is the remainder of the milk after the better part has been taken from it.) Whey; the yellow fluid which separates from blood when cold and at rest.

Signs Chemical. (*Signes Chimiques.*) The creation of chemical signs which at once indicate the name and the proportion of the elements which compose a substance, is to be attributed to Berzelius. We shall here quote from his "*Théorie des Proportions Chimiques.*"

When we wish to express chemical proportions, we find it necessary to have chemical signs. They have long been employed, although hitherto with little real advantage. When alchemy flourished, chemical signs were created, for the purpose of having a language mystical and incomprehensible by the vulgar. The antiphlogistic chemists wished to substitute for these, others founded on the same principles as the new chemical names. The sign was to indicate the constituent parts of a compound body; but although these signs were well chosen, they were, it must be acknowledged, almost useless; for it is more easy to write an abridged word than to delineate a figure, which, in order to be understood, required to be larger than the ordinary characters of writing. In proposing other signs, says Berzelius, I shall endeavour to avoid these inconveniences. I should, however, observe that these new signs are not created with a view of labelling substances in the laboratory, as the ancients did; but it is intended by them to ascertain the expression of chemical proportions, and to enable us to announce briefly, and with facility, the number of elementary atoms, which are found in every compound. By knowing the relative weight of the atoms of simple bodies, we can, by means of these signs, express the result of every analysis, in a manner at the same time simple, and easy to be remembered.

Chemical signs ought to be alphabetical letters, that they may be easily written and printed, and without disfiguring the text. I would select then for this purpose the initial letter of the Latin name of each simple body; but many of these bodies having the same initial, I will thus distinguish them: 1st. The simple bodies non-metallic (*metalloides*) shall be designated only by the initial letter, although even that letter shall be common to some metal. 2d. A metal, having the same initial as another metal or metalloid, shall be designated by the first two letters of its name; or if they are found in another name, add to the initial the first different consonant; for example, S = sulphur, SI = silicium, ST = stibium,* SN = stannum,† C = carbonicum, CO = cobaltum, CU = cuprum,‡ O = oxygenium, OS = osmium.

The chemical sign never indicates but one atom; when it is necessary to express many, place a cipher at the left of the sign; for example, $CU+0$ designates the oxidule (protoxide) of copper; $CU+{}^{2}0$ the deutoxide of copper. But, in order to express an atom composed of the second order, according to the above method, too long a formula would be necessary; we would then abridge as follows: oxygen entering into most combinations, and often by a number of atoms, we would express this by points upon the oxidated radical, placing as many as there are atoms of oxygen in the oxide; for example, the oxide of copper protoxide = $\dot{C}U$, and the deutoxide of copper = $\ddot{C}U$; sulphurous acid = $\ddot{S}$, and sulphuric acid = $\dddot{S}$; this would show that the oxidule of copper contains 1 atom of oxygen, that the deutoxide of copper and sulphurous acid each contain 2 atoms of oxygen, and that sulphuric acid contains 3 atoms of oxygen.

A salt composed of two substances, for example, the sulphate of the oxidule (protoxide) of copper, would be expressed by $\dot{C}U\dddot{S}$; and when there are in the compound several atoms of one of the combustible bodies, the number is expressed by a little figure at the top and on the right of the letter, as in algebra; for example, $CU\ddot{S}^{2}$ signifies the sulphate of the oxide of copper, and indicates that this salt contains 2 atoms of sulphur or sulphuric acid. This formula then shows at one view the relation between the acid and the base, between the radicals and between the oxygen of the oxidated bodies. I have found, says Berzelius, that this method gives great facility for expressing by writing the composition of bodies, according to the theory of chemical proportions.

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* Antimony. † Tin. ‡ Copper.

It is equally easy to express by signs the composition of atoms of the third order; for example, $\dot{C}\mathrm{A}\,\ddot{C}^2+\ddot{M}\,\mathrm{G}\,\ddot{C}^2$ expresses the double mineral salt known by the name of *dolomite* (*chaux carbonatée magnésifère*), which is composed of one atom of the carbonate of lime, (*carbonate de chaux*,) and one atom of the carbonate of magnesia. If several atoms of one of these substances enter into the compound atom, the number of these atoms is marked by a figure on the left; for example, the formula of alum (*kaline sulphate of alumine*) is $\ddot{K}\,\ddot{S}_2+2\ddot{A}\mathrm{L}\,\ddot{S}_3$.

In order to express the compound atoms of the fourth order, enclose by parentheses each atom of the third order; thus, for example, the atom of crystallized alum would be expressed by $(\ddot{K}\,\ddot{S}_1+2\ddot{A}\mathrm{L}\ddot{S}_3)+48H^2O$, being composed of one particle of the third order combined with 48 particles of water; the atom of water might be expressed by $+A2$, *aqua* being the Latin for water.

With respect to organic bodies, their formulas, according to these rules, would in general be too complicated; however, in expressing the salts of many vegetable acids, the atoms of acid may be expressed by the initial letter of its Latin name, with a mark to show that they are of inorganic origin; for example, $\bar{C}$ = citric acid, $\bar{T}$ = tartaric acid, $\bar{A}$ = acetic acid; and when different acids have the same initial letters, they may be distinguished by the same method as that pointed out for the metals. It may be seen how much this method of expressing the composition of bodies abridges labour, showing at first glance the name of a compound, its proportions, and the relations which exist between these proportions in the compounds of the second and third order, &c.

Silex. See *Oxide of Silicium.*

Silicium. *Silicon.* Berzelius is the only chemist who has succeeded in insulating the base of silex. We shall therefore quote from his *memoire*, published in the Annals of Chemistry, vol. XXVII. page 341. This chemist states that silicium is of a nut brown, without metallic brilliancy, of an earthy appearance; that it burns neither in the air nor in oxygen, bearing even the flame of the blow pipe without any alteration; it has never yet been fused. Silicium presents this unchangeable character, only when very pure; if it contain a little hydrogen and be heated to redness, the hydrogen will inflame and at the same time the silicium. Silicon adheres strongly even when dry to the sides of the glass vessels in which it is preserved. It does not conduct electricity.

Silicium, when heated with the carbonate of potash, burns easily, disengaging much caloric and light; it forms the oxide of carbon, the mass taking a black appearance, which it owes to the carbon not burnt. Silicon burns at a low temperature more easily with the carbonate than with the nitrate of potash; the affinity of alkali for silex seems necessary in order to produce the combination of silicium, which is not manifested with the nitrate except when the temperature is sufficient to decompose the nitric acid; and if the mass burned remains black for some time, it is because the new combination, which is compact, protects the charcoal until it fuses.

When a mixture of silicium and the hydrate of potash or soda is heated, there is, at a certain temperature, a detonation and a combination of the two oxides, (silex and potash,) and a disengagement of hydrogen. Silicium heated to redness in the vapour of sulphur burns, though with a less vivid flame than in oxygen; except with very pure silicium no combustion takes place. The sulphuret is an earthy white substance; if thrown into water, it dissolves, disengaging sulphuretted hydrogen. The silex formed dissolves in water, which becomes a jelly by slight evaporation. Where the sulphuret is with an excess of silicium the same phenomena appear, and a deposite of silicium is obtained. The siliciuret of potassium easily combines with sulphur at a red heat; a double sulphuret is formed which brought in contact with water dissolves it, producing probably the silicate of potash and the hydro-sulphuret of potassium. It is singular that silex can dissolve in water in so great a quantity when forming, and wholly lose this property by evaporation. This astonishing solubility throws great light upon the formation of druses, or collections of silicious crystals, which often exist in cavities of quartz, agate, and many other minerals, cavities which are sometimes almost filled with these crystals, and which contain a quantity of liquid exceeding their volume.

Berzelius was not able to combine silicium with phosphorus, but he combined it with chlorine, by heating it in this gas. The product is a yellow liquid when it contains an excess of chlorine, but otherwise it is entirely colourless. Its odour resembles that of cyanogen; it reddens the tincture of litmus, swims upon water, and usually dissolves in it, disengaging hydrogen; it may be dissolved in a mixture of cold fluoric and nitric acids, disengaging nitrous gas. In its state of combustibility it dissolves in a solution of caustic potash, but after calcination all attempts to dissolve it are vain.

Insulated silicium with difficulty combines with metals; it appears to have the greatest affinity for platina; their union however cannot be affected without the medium of a third substance.

Silicium is obtained by decomposing the double fluate of silex and soda; this last containing more of the fluate of silicon than any other; this is powdered and dried, *then with layers of* potassium put into a glass tube closed and heated, the silicium is reduced with a slight hissing and without any disengagement of gas, provided that the salt contains no water; this mass is left to cool, then treated with a great quantity of cold water; when this water is no longer alkaline, hot water is employed, and the mass is then boiled with new water. Silicium thus obtained contains a little hydrogen and silex; the hydrogen is driven off by a careful calcination, this renders it insoluble; even fluoric acid which dissolves silex has no effect upon silicium thus calcined. If however the silicium were not pure, containing, for example, a little iron or manganese, it would dissolve in acid, disengaging hydrogen, and 100 parts of silex would absorb 108·22 of oxygen in order to pass to the state of silex. It may be seen, from what has been said upon silicium, that it ought not to be placed among the metals; even if by fusion it can take a metallic brilliancy, its other properties, and particularly that of being a non-conductor of electricity, must be a sufficient barrier to its receiving a rank among metals. It has been seen that it has no great affinity for oxygen. It is perhaps possible to judge of the affinity of a simple body for oxygen by its tendency to combine with other bodies, and particularly by the affinity of its oxides for acids. If this principle is admitted we should regard potassium as the body which has perhaps the most affinity for oxygen and silicium as one of those which have the least. Although experiment has not perfectly established this principle, the character of silicium adds a new degree of probability to the hypothesis. Berzelius would place silicium with boron and carbon.

Silver. (*Argent.*) A metallic substance, white, ductile, having great tenacity, fusing but at a high temperature. Its specific gravity is 10·39. Its primitive form is the cube, its secondary forms are the octoedron and its modifications. It volatilizes when heated in close vessels. In contact with the air, it absorbs at a certain temperature a small quantity of oxygen, which on cooling is disengaged. It combines with sulphur, phosphorus, chlorine, and iodine; its combination with iodine is remarkable in being insoluble in ammonia. Sulphuric acid acts upon silver only when assisted by heat; but nitric acid dissolves it at the ordinary temperature. Most other acids, even when concentrated, have no action upon it.

Silver is often found pure in a native state, frequently sulphuretted, alloyed with other metals, and sometimes, though not often, combined with chlorine. Much silver is extracted from the sulphuret of lead, and some from copper pyrites. The value of silver is so great that mines, though containing it but in very small quantities, are usually wrought. When the silver is found in large masses, as in Mexico and some other countries, it only needs melting in order to obtain it pure; but it is usually obtained from the sulphuret by means of lead or mercury; when the latter metal is employed, amalgamation can take place only as far as the silver is not in combination. It must then first be brought to a metallic state; for this purpose it is roasted in furnaces with a certain quantity of common salt, (chloride of sodium,) and the chloride of silver is formed. The minerals are then pulverized and put into vessels which turn upon an axis, or a kind of mill. Mercury, water, and old iron are then added; these decompose the chloride, and the silver being set free, combines with the mercury. This amalgam being subjected to pressure in bags of a close texture, one portion of mercury escapes; the amalgam is then put upon large wooden perforated plates, which are placed one above another over iron vessels; the amalgam is at first lightly heated, the temperature is gradually raised, and the whole of the mercury flows down and falls into the iron vessels below.

SILVER HORNED. (*Argent Cornée.*) See *Chloride of Silver.*

Silver Fulminating. (*Argent Fulminant.*) See *Cyanates.*

Siphon. A name given to a tube bent in such a manner that one branch is longer than the other. Siphons are sometimes made of glass, more frequently of metal; they are used for transferring liquids from one vessel to another; for this purpose the shortest branch is put into the liquid; by sucking with the mouth at the other aperture the air is drawn from the siphon and the liquid immediately rushes up the tube and fills the vacuum. If the liquid is caustic, or of a nature that might render it disagreeable to perform this operation with the mouth, the liquid may be drawn by expelling the air from the siphon by first filling it with water.

Soap. (In Latin, *Sapo;* French, *Savon.*) It is the product of saponification; it consists of a union of the stearates, margarates, and oleates of soda or potash; salts which are capable of combining with these substances in all proportions, and of being soluble in water; they combine however in different quantities. The soaps of vegetable oils and of human fat are formed of the margarate and oleate of potash or soda in variable proportions. They are hard, as these bodies contain more of the margarate in proportion to the oleate. Soaps made of the grease of pork, mutton, and beef, in addition to these two salts, contain stearate, and are hard in proportion as its quantity is greater. Besides this cause of hardness, much depends upon the base, viz. whether it be soda or potash; the latter produces *soft soap,* the former *hard soap.* The stearate of soda may be considered as forming the hardest soaps, and the oleate of potash the softest. The hardness of soap is also increased by exposure to the air, and evaporation from any cause; but soft soap based upon potash cannot be dried like soap made with soda, and is much more soluble.

The solubility of soaps is thus ascertained to depend on the nature of their alkaline base, and the fat with which it combines; now as the stearines are changed into stearic and margaritic acids, and the elain (*oléine*) into oleic acid, to a certain degree the hardness of soap, which will be produced by each fat substance, may be foreseen; it will for this purpose only be necessary to ascertain the proportions of stearine and elaine which they contain; this can be known by their degree of fusibility. Then by adding to the oils which form only soft soap with soda, a substance which abounds in stearine, a hard soap may be obtained.

Soaps may be odorous or inodorous; in the latter case their odour is due to the presence of a volatile acid; such as the butyric, caproic, and capric acids, in the soap made of butter; the phocenic acid in the soap made of dolphin's oil, and the hircic acid in the soap of suets. (Chevreul's Chemical researches upon fat substances.)

Hard soap is made by combining caustic soda with sweet oil or the fat of beef or mutton. Soaps based upon potash or soda, are the only kinds which are used in the washing of clothes. The specific gravity of soap is usually greater than that of water. Its taste is slightly alkaline. When subjected to heat, it fuses, swells, and decomposes. The medicinal soap, (*sapo amygdolinus*,) is made with the oil of sweet almonds, and half its weight of caustic alkali. Common or soft soap (*sapo mollis*) is made of potash (obtained from leaching common wood ashes) and animal fat. Spanish or Castile soap (*sapo durus*) is made of oil of olives and soda.

SODA. (*Soude.*) See *Oxides of Sodium*.

SODA VITRIOLATED. An ancient name of the sulphate of soda.

SODIUM. The discovery of this metal, as well as of potassium, was made by Sir H. Davy; it has been studied with great attention by Gay-Lussac and Thenard; our remarks upon it will be chiefly borrowed from them. This metal has much analogy with potassium, both in its properties and the methods of obtaining it. It is solid, inodorous, soft, and ductile. Like wax, it is of a lead gray colour; its fracture is very brilliant; its density is 0·972, at the temperature of 59°. It fuses when exposed to the action of caloric at 194°, and does not volatilize at a much higher temperature. When exposed in oxygen gas or very dry air, it is not like potassium, destroyed; it is only when fused in this gas, that it absorbs oxygen, producing a yellow compound, which is a mixture of the protoxide and the deutoxide of sodium. Like potassium, it decomposes water, but without any elimination of light. It does not combine with hydrogen, but unites with most other combustible bodies, and even with nitrogen. A substance which has so great a tendency to form combinations, does not of course exist pure in nature; it is very abundant in combination with chlorine, in the state of common salt, (chloride of sodium) and exists in many other natural compounds.

Solanine. (*Solania.*) A peculiar vegetable substance which has been discovered in the fruits of the garden night shade, (*Solanum nigrum,*) in the leaves and stems of the bitter sweet (*Solanum dulcamara,*) where it exists in combination with malic acid. It is a white pulverulent opaque substance, with a pearly (*nacré*) appearance, a very bitter taste, fusible at 212°, and decomposable at a much higher temperature. Like the vegetable alkalies, it is very soluble in alcohol, scarcely soluble in ether, the essential oils, and boiling water. It forms with acids very bitter and uncrystallizable salts. M. Desfosses, who discovered solanine, obtained it by adding ammonia to the filtered juice of the garden night shade; this formed a gray precipitate which he collected upon a filter, and which when washed, treated with boiling alcohol, and evaporated, deposited the solanine.

Solution. (From *solvo*, to loosen.) An intimate mixture of solid bodies with fluids, into one seemingly homogenous liquor. The dissolving fluid is called a menstruum, or solvent. (For the distinction made by the French between *solution* and *dissolution*, see the latter word.)

Sorbates. See *Malates.*

Soude. *Soda.* See *Oxide of Sodium.*

Spirit Volatile. (*Sal ammonia.*)

Spar Fluor. (*Spath Fluor.*) Native fluate of lime.

Spar Heavy. (*Spath Pesant.*) Native sulphate of barytes.

Spelter. The zinc of commerce.

Spirit Ardent. See *Alcohol.*

Spirit of Mindererus. See *Acetate of Ammonia.*

Spirit of Nitre. (*Foaming.*) See *Nitrous Acid.*

Spirit Pyro Acetic. (*Esprit-Pyro Acetique.*) Pyro-acetic acid; from *acetum*, vinegar, and the Greek *pur*, fire, it being made by the agency of fire on acetic acid. It is a colourless liquid, of a peculiar taste, and odour between that of mint and bitter almonds. It boils at 138°, and does not congeal at 50°. It burns very easily, and mixes in all proportions with water, alcohol, the fixed and volatile oils. Cold sulphuric acid decomposes it without forming ether; it combines with sulphuretted hydrogen; potash has no sensible action upon it. As the pyro-acetic spirit dissolves camphor, it is used in pharmacy for dissolving that which enters into anti-septic (*anti-putrescent*) vinegar. It is obtained by a destructive distillation of the acetates.

Spirit of Salt. Hydro-chloric or muriatic acid.

Spirit of Sulphur. Sulphurous acid.

Spirit of Wine. Alcohol.

Spirit of Venus. Acetic acid.

Spirit of Vitriol. Sulphuric acid.

Stalactites. These are found suspended from caverns, being formed by the trickling of water charged with calcareous particles, gradually evaporating, leaving the particles of lime behind.

Stalagmites. (From the Greek *stalagmos*, a dropping or distillation.) Formed in the same manner as stalactites, except that they exist at the bottoms of caves, and the former are suspended from the roofs.

Starch. (*Amidon*, Latin *Amylum.*) This is one of the principles most abundant in vegetables; it exists in the seeds, roots, stems, and leaves. When pure, it is a white powder, insipid, inodorous, insoluble in cold water, alcohol, and ether, but soluble in boiling water; this solution on cooling takes the form of a jelly; hot sulphuric acid transforms starch into a sugared substance, capable of yielding alcohol by fermentation; concentrated sulphuric acid poured upon starch, chars it; nitric acid transforms it into malic and oxalic acids.

Starch combines with iodine in different proportions; the colour of their compounds is blue, varying in shades according to the proportions of iodine; a beautiful blue colour may always be obtained by treating starch with an excess of iodine, dissolving the compound with liquid potash, and precipitating it by a vegetable acid. According to Gay-Lussac and Thenard, starch is composed of

43·55	parts	carbon
49·68	"	oxygen
6·77	"	hydrogen.

Saussure discovered a small quantity of nitrogen, which Berzelius was not able to find.

Starch is usually obtained by grating the roots which contain the fecula and washing the product with pure water. Its specific gravity being greater than that of water is soon deposited. Starch for common domestic purposes, is usually obtained from wheat, potatoes, indian corn, &c. As starch forms the greater part of flour, it is probably the principal nutricious substance in bread. It is of use in medicine.

Stearates. Stearic acid combines in many proportions with salifiable bases ; according to Chevreul, it can form neutral stearates, and acid or bi-stearates ; in the first, the oxygen of the oxide is to the quantity of acid as 3 to 100 ; and in the acid stearates, in the relation of 3 to 200.

Stearate of Ammonia. (*Stéarate d'Ammoniaque.*) White, almost inodorous, of an alkaline taste ; it sublimes in a vacuum. If heated in a retort in contact with the air, it decomposes, water is formed, ammonia disengaged, and a portion of the stearate mixed with an empyreumatic oil sublimes. It is soluble in hot water, particularly with a little excess of alkali ; and the solution on cooling deposites the bi-stearate under the form of brilliant scales. It is obtained by putting hydrated and fused stearic acid in contact with ammoniacal gas. The absorption is at first very rapid, and continues for a long time. The stearate of very dry ammonia is formed of 100 parts of acid and 6·68 of base.

Stearate of Barytes. (*Stéarate de Baryte.*) White, insipid, inodorous, fusible at a moderate temperature ; it is obtained by a direct process, but the operation must be carried on in contact with the air, on account of the carbonic acid which it contains. It is composed of 100 parts acid to 28·72 of the base.

Stearate of Lead. (*Stéarate de Plomb.*) The neutra stearate of lead is obtained by mixing in a boiling state, two aqueous solutions of the stearate of potash and the nitrate of lead. It is composed of 100 of acid, and 41·84 of the base. The sub-stearate of lead which is without colour, friable, and very fusible, is obtained like the preceding, substituting the sub-acetate of lead for the nitrate. It is composed of 100 of acid and 85·18 of the base.

Stearate of Lime. (*Stéarate de Chaux.*) Is obtained by pouring into a boiling solution of the chloride of calcium, a boiling solution of the neutral stearate of potash. It consists of 100 of acid and 11·06 of the base.

Stearate of Potash. (*Stéarate de Potasse.*) The neutral stearate is in little spangles, or in large scales, brilliant, transparent, of a soapy touch, and a slightly alkaline taste; 100 parts of boiling alcohol can dissolve 15 parts of it. It forms a mass on cooling, it also dissolves in ether; but the last having a greater affinity for stearic acid than for potash changes the composition of the salt, dissolving more of the acid than the base. Water does not dissolve the stearate of potash but at an elevated temperature; when employed cold, and in a small quantity, it forms with this salt a thick mucilage; if used in sufficient quantity, it changes this stearate into potash, which is dissolved, and an insoluble bi-stearate. This neutral stearate of potash is obtained by heating 2 parts of stearic acid and 2 parts of potash in 20 parts of water; the stearate forms and is then purified by alcohol. It consists of 100 of acid and 18 of the base.

The *bi-stearate* of potash is in little brilliant scales, inodorous, and of a soapy touch. It does not fuse at 212°; cold water has no action upon it, but boiling water separates a portion of its alkali, and the residue not dissolved can form with boiling alcohol, a solution which on cooling, is reduced to a bi-stearate of potash, which crystallizes, and stearic acid which remains in the liquor with a portion of the bi-stearate. The bi-stearate of potash is obtained by pouring a boiling solution of the neutral stearate into a great quantity of cold water, collecting the precipitate, and dissolving it in alcohol; it crystallizes on cooling. It consists of 100 of the acid and 8·97 of the base.

Stearate of Soda. (*Stéarate de Soude.*) This salt is in brilliant crystals, or semi-transparent scales, at first tasteless in the mouth then alkaline. It is soluble in 20 parts of boiling alcohol. Boiling sulphuric ether separates from it a little stearic acid, which, however, retains a trace of the soda. The stearate of soda can solidify a great quantity of water; it dissolves in boiling water. The *neutral stearate of soda* is obtained by heating together a mixture of 20 parts stearic acid, 13 parts soda, and 300 parts of water, and treating the product with alcohol. This salt is formed of 100 of acid and 12·33 of soda. The *bi-stearate of soda* is white, insipid, inodorous, more fusible than the neutral stearate, insoluble in water, very soluble in alcohol. The alcoholic solution reddens the tincture of litmus; it becomes alkaline by the addition of a certain quantity of water. It is obtained by dissolving with heat, the neutral stearate in a great quantity of water, leaving the liquid to cool, and treating the precipitate with alcohol. It is formed of acid 100 and base 6·01. The stearates of potash and soda enter into the composition of most kinds of soap.

STEARATE of STRONTIAN. (*Stéarate de Strontian.*) White, inodorous, insipid, is prepared like that of barytes. It is composed of

Acid - - -	100
Strontian -	19·54.

STEARINE. A fatty substance, white, less shining than stearic acid, fusible at 111°, forms acicular crystals. It volatilizes in a vacuum without being decomposed; it gains odour by contact with the air; it burns like suet, but if heated in a retort, one part decomposes, giving rise to different products not azoted; and the other part volatilizes. Sulphuric and nitric acid decomposes it. Such are the properties presented by the stearine extracted from the fat of beef, pork, and mutton; that which is extracted from human fat, differs chiefly, in not giving stearic acid by saponification. Stearine is obtained by treating successively fat substances with alcohol, which dissolves more elaine (*oléine*) than stearine.

It consists of 9·454 oxygen,
78·776 carbon,
11·770 hydrogen.

Steel. (*Acier*, French ; *Chalybs*, Latin.) The *proto-carburet* of iron, presenting nearly the same characters as this metal. It is susceptible of a very high polish ; if a drop of nitric acid is poured upon steel, a black spot will appear ; this is owing to the presence of carbon. Very small quantities of steel have been found in nature ; that which is used in the arts is usually prepared by heating, for a long time, iron in contact with powdered charcoal. Among the several varieties of steel, that which is most common consists of 1000 parts of iron, 6 parts of charcoal, and a small quantity of silicium.

Stibium. (From the Greek *stilbo*, to shine.) An ancient name for antimony.

Stimmi. (From the Greek *stimmi.*) Antimony.

Stone Philosopher's. (*Grand Œuvre.*) A name given by alchemists to an imaginary preparation which was to change all metals into gold and silver.

Strontian. (So called because it was first discovered in a lead mine in Strontian in Scotland.) See *Oxide of Strontian.*

Strontium. The metallic base of strontian ; its properties are scarcely known. It resembles calcium, and like that base has been obtained only by means of the voltaic pile.

Strychnine. A salifiable vegetable base, white, pulverulent, of an excessively bitter taste. If examined with a microscope, it will be found to be composed of many small prismatic crystals. It is scarcely soluble in boiling water and ether, but dissolves well in alcohol and the volatile oils. Exposed to the action of fire, it decomposes, giving off ammoniacal products. It unites with acids, forming salts soluble in water, and susceptible of crystallization. These salts are sometimes neutral, sometimes acid, and sometimes with an excess of base. It is obtained directly by double decomposition. The strychnine is found in different parts of the *strychnos*, in combination with igazuric acid: it is usually extracted from the seed of the *Strychnos nux vomica*, which also contains a quantity of brucina. An infusion of the vomica nuts is treated with magnesia; the precipitate treated with weak alcohol, which takes up the greatest part of the brucine, it is afterwards treated by concentrated and boiling alcohol, which unites with the strychnine, and deposites it on cooling; it is purified by new crystallizations. It is composd of

Carbon . . .	78·22
Azote . . .	8·92
Hydrogen . .	6·54
Oxygen . .	6·38

It was discovered by Pelletier and Caventon.

Suber. Cork, a vegetable substance, from the *Quercus suber*.

Suberates. These substances have been studied by M. Bouillon-Lagrange; according to him, those of potash, soda, and ammonia, are very soluble; most of the others are insoluble.

Suberine. A name given by Chevreul to the cellular tissue of the cork tree, which changes to suberic acid by the action of nitric acid.

Sublimation. (From *sublimo*, to raise, or sublime.) A process by which volatile substances are raised by heat, and again condensed in a solid form; the vapours usually condense in the upper part of the vessel. Fluids are said to be distilled, and solids to be sublimed; though sometimes both are obtained in one and the same operation. If the subliming matter concretes into a solid hard mass, it is commonly called a sublimate; if into a powdery form, flowers. Solids condense more easily than fluids.

Sub-Salt. (*Sel-Sous.*) A salt having an excess of base, beyond what is requisite for saturating the acid, as a *super-salt* is one with an excess of acid.

Succinates. (From *succinum*, amber.) Little is known respecting these substances; that of potash is deliquescent; those of soda and ammonia are very soluble. They are obtained directly by double decomposition. The succinnate of ammonia is employed to separate the oxide of iron from the oxide of magnesia; it does not precipitate the latter. According to Berzelius, the quantity of oxygen of the oxide is to the quantity of acid as 1 to 6·28.

Sugar. (*Sucre.*) This name was formerly given to all substances whose taste resembled that of the sugar-cane and which were not very unlike in appearance; at present we limit the term to those substances which, when brought in contact with water and a very small quantity of yest, produce alcohol. The other characters may be variable; there are therefore many kinds of sugar. The sugar obtained from the cane (*Arundo saccharifera*) is the most important. This sugar when pure is colourless, inodorous, of an agreeable taste; its density is 1·6065. It is insoluble in half its weight of cold water, and in all proportions in boiling water; susceptible of crystallization in rectangular octoedrons whose pyramids are truncated near their base; these crystals contain little of the water of crystallization. In certain circumstances sugar may lose its property of crystallizing; this takes place when its watery solution is kept for some time in the air, exposed to a heat of 158°; it then becomes an uncrystallizable sugar known by the name of *molasses*, (*mélasse.*)

When exposed to the action of fire, sugar swells, diffuses a peculiar smell called the odour of *caramel*, and leaves an abundant charcoal. Sugar forms but feeble combinations with metallic oxides. If lime, barytes, or trontian are boiled with sugar, they become bitter, astringent, and uncrystallizable; by adding a sufficient uantity of an acid to neutralize the oxide, the sugar esumes its properties. Sulphuric and nitric acids decomose sugar; nitric acid changes it to oxalic acid. Its olution is not precipitated by that of the sub-acetate of ead. Although this kind of sugar exists in many plants. t is chiefly obtained from the sugar-cane, the sugar-maple, (*Acer saccharinum,*) and the red beet. According o Gay-Lussac, sugar is in weight composed of

Carbon	42·47
Oxygen	50·63
Hydrogen	6·90

SUGAR CANDY. (*Sucre Candi.*) Crystallized sugar, when pure is colourless, but is usually coloured in making.

SUGAR of GELATINE. A name given by Braconnot to a peculiar substance formed by the action of sulphuric acid upon gelatine. This substance does not yield alcohol by fermentation; it consists of groups of hard granular crystals; they crack under the teeth, and have a sugared taste. If exposed in a retort to the action of heat, they fuse at first and then decompose, forming a white sublimate and ammoniacal product. They are soluble in water and insoluble in alcohol; nitric acid changes them to a peculiar acid which Braconnot called *nitro-saccharique.*

SUGAR of GRAPES. (*Sucre de Raisin.*) This offers properties similar to the sugar of the cane; it differs from it in not crystallizing regularly, in being less soluble in cold alcohol, and in having a taste of sugar less strong, as it requires twice as much as the sugar of the cane to sweeten the same quantity of water. This sugar exists ready formed in many fruits, and can be obtained by treating starch and other analogous substances with water and sulphuric acid. It is usually extracted by saturating with the carbonate of lime the expressed juice of the grape. According to Saussure, it consists of

Carbon	36·71
Oxygen	56·51
Hydrogen	6·78

Sugar of Lead. (*Sucre de Plomb.*) See *Acetate of Lead.*

Sugar of Milk. (*Sucre de Lait.*) A peculiar substance obtained from milk, and which when brought in contact with water and yest does not produce alcohol; it is not therefore a true sugar. It is a solid, inodorous substance, having a sugared taste, heavier than water, capable of forming semi-transparent crystals; concentrated alcohol cannot dissolve the sugar of milk; it is therefore used as a test for detecting the presence of this substance, with which the sugar of the cane is sometimes adulterated. It is obtained by evaporating whey (*le petit-lait*); it deposites in compact layers, which are purified by new crystallizations. According to Gay-Lussac and Thenard, it consists of

Carbon	38·825
Oxygen	53·834
Hydrogen	7·341

Sugar of Mushrooms. (*Sucre de Champignons.*) White, has not the pleasant taste of the sugar of the cane. It is obtained by pounding mushrooms in a marble mortar, diluting the pulpy substance with water, filtering the liquor, evaporating it, and treating successively with alcohol the brown mass which is formed. It crystallizes in elongated four-sided prisms.

Sugar of Starch. (*Sucre d'Amidon.*) Starch made into a paste and left to itself for some time produces a certain quantity of sugar. Sulphuric acid converts starch into sugar; if a mixture of water, starch, and sulphuric acid is boiled for a certain time, the acid will not be decomposed; for if carbonate of lime is added, it will unite with it, and form sulphate of lime. Saussure found that the weight of sugar formed was considerably more than the weight of the starch employed; that 100 parts of starch gave 110·14 of sugar; from whence he concluded that a part of the water was solidified, and thus the acid acted only by increasing the fluidity of the liquor.

Sulphates. (*Sulfates.*) Of all the acids none has a more marked tendency to combine with salifiable bases than sulphuric acid; there are of course many sulphates. This acid forms *neutral sulphates*, *sub-sulphates*, *acid sulphates*, and many of these can combine among themselves, forming *double sulphates*.

When we examine the laws of combination of these salts, we find, 1st, in the neutral sulphates, the quantity of the oxygen of the oxide is to the quantity of the oxygen of the acid, as 1 to 3, or the quantity of acid, as 1 to 5. 2d. The sub-sulphates are not uniform in their composition; sometimes they contain once and a half as much oxide as the neutral sulphates, sometimes 3 times as much, or even 6 and 12 times the same quantity; these numbers are multiples of the smallest quantity by 2, by 4, and by 8. Berzelius has even observed many sub-sulphates of the same base. 3d. The acid sulphates contain for the same quantity of base, a quantity of acid, which is exactly twice as great as that which the neutral sulphates contain. 4th. In the double sulphates the quantity of oxygen of one of the bases is proportionate to the quantity of oxygen of the other base; thus for example in alum, (*acid sulphate of alumine and potash,*) the quantity of oxygen in the potash is to the quantity of oxygen in the alumine as 1 to 3; then the quantity of acid united to the alumine will be three times as great as the quantity of acid united to the potash, since the quantities of acid must be in proportion to the quantity of oxygen contained in the bases.

Sulphates exposed to the action of caloric, at first disengage their water of crystallization, and with the exception of the sulphates of Thenard's second section,* and the sulphate of magnesia, are all decomposed, if the temperature is sufficiently elevated. Their acid is transformed into two volumes of sulphurous acid, and one volume of oxygen, and the oxide is reduced. In some cases, as when a metal has much affinity for oxygen, the oxygen of the sulphuric acid decomposed serves to raise the oxide to a higher degree of oxidation; this is the case with iron in the preparation of colcothar or the tritoxide of iron.

Most combustible non-metallic bodies can, with the aid of heat, decompose the sulphate; *carbon*, producing carbonic acid, and an oxide or rather a sulphuret; *hydrogen*, forming water and hydro-sulphuric acid, (sulphuretted hydrogen;) *sulphur*, producing sulphurous acid and an oxide or sulphuret, &c. This last combustible substance cannot, however, decompose the sulphates which resist an elevated temperature. *Water* acts variously upon these; it decomposes many of the neutral sulphates, changing them into an acid sulphate and subsulphate; it dissolves many, but in a variable quantity. The most soluble is that of alumine; that of barytes is wholly insoluble, and it is this base which has the greatest tendency to combine with sulphuric acid; thus *all* the sulphates disturb the water of barytes. Many other salts may also be thus affected, and the precipitate formed should not be regarded as the sulphate of barytes, but when nitric acid will not dissolve it. Some *hydracids* can, in peculiar circumstances, and at the ordinary temperature, decompose the sulphates; at an elevated temperature, *boracic* and *phosphoric acids* decompose them, uniting with their base and forming a borate or a phosphate, and setting free the sulphuric acid, which, not being able to exist alone, is transformed into sulphurous acid and oxygen. The great affinity of sulphuric acid for bases gives rise to many native sulphates; those which are insoluble are usually derived from the decomposition of the sulphurets, by the contact of damp air, and are often dissolved by the waters which traverse the galleries of mines, as they are found in springs whose sources pass through earth which contain sulphates or the materials for forming them. Those which are employed in the arts are usually extracted from native minerals; some are prepared directly by art, and many by double decomposition. See each *Sulphate.*

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* See the article *Metals*.

Sulphate of Alumine. A white, deliquescent salt, very soluble, of an astringent taste, reddens the tincture of litmus, crystallizes in groups. The solution of the sulphate of potash or ammonia, poured into its concentrated solution, immediately forms a crystalline precipitate of alum. It exists in nature, but always with an excess of base, and containing some water; it is known by the name of *alumite* or *aluminate.* It is obtained directly by treating alumine in a jelly with sulphuric acid. It is also procured by burning mixtures of pyrites and argillite. Sulphuric acid acts upon alumine and forms the sulphate which is obtained by lixiviating and then evaporating the liquor. It is employed in preparing alum; some of the sulphate of ammonia, or the residues of the distillation of nitric acid are also added.

Sulphate of Alumine and Potash. *Acid.* See *Alum.*

Sulphate Ammoniaco-Magnesian. The double sulphate of magnesia and ammonia. This last base, poured into a solution of the sulphate of magnesia, precipitates a portion of the magnesia, and takes its place.

Sulphate of Ammonia. A colourless salt, of a bitter and pungent taste, crystallizable in hexagonal prisms terminated by points with six sides. If exposed to the action of caloric, it at first loses a portion of ammonia, passes to the state of an acid sulphate, which at a temperature a little more elevated, decrepitates and decomposes, giving rise to nitrogen, water, and the volatile sulphite of ammonia. This salt is very soluble, since it dissolves in two parts of cold water, and in its weight of boiling water. It exists in small quantities in nature. It is usually prepared by directly uniting ammonia to sulphuric acid. In the arts, great quantities of sulphate of ammonia are made in the preparation of the hydro-chlorate, (muriate of) ammonia. Animal substances are for this purpose distilled in iron cylinders; the product of this distillation is conducted into vessels which contain gypsum, (sulphate of lime,) diluted with water. A great quantity of oily matter collects upon the surface, which is removed. The sub-carbonate of ammonia, which is one of the products of this distillation, decomposes the sulphate of lime, and forms a sulphate of ammonia. It is by subliming a mixture of this sulphate and of chloride of sodium, (common salt,) that the hydro-chlorate of ammonia is obtained.

SULPHATE of ANTIMONY. The oxide of antimony has little affinity for acids; a sulphate is, however, obtained by heating metallic antimony with 5 times its weight of concentrated sulphuric acid. This sulphate is white, heavy, and contains an excess of acid. When brought into contact with water it changes into a very acid sulphate, which remains in solution, and a sub-sulphate, which is precipitated. See *Tartrate of Antimony and Potash.*

SULPHATE of BARYTES. A very heavy, white salt, hard, inodorous, insipid, wholly insoluble in water, and only soluble in a concentrated solution of sulphuric acid. Exposed to the action of heat, it fuses at a very elevated temperature, but does not decompose unless it is in contact with some combustible substance like charcoal, vegetable substances, &c. It exists extensively in nature, usually accompanying metals in veins, seldom in beds. It is often associated with antimony and the per-oxide of manganese, it is then called heavy spar (*spath pesant*). Its crystals which were formerly supposed to be in rhomboidal prisms, are more like rhomboidal octoedrons; they are often flat and tabular and grouped like the steps of a ladder. The sulphate of barytes is found in a fibrous and even in an earthy state, but usually crystallized; in its system of crystallization it resembles the sulphate of lead. It may always be distinguished from that sulphate by sulphuretted hydrogen, or any alkaline sulphuret which forms a black spot upon the sulphate of lead. The natural sulphate of barytes is employed to obtain barytes. In order to obtain this sulphate in a state of purity, it may be prepared by decomposing the sulphate of soda with the nitrate of barytes, and washing the precipitate.

SULPHATE of BISMUTH. White, compact, acid; it is decomposed by water into a very acid sulphate, and a sub-sulphate which is precipitated. It is obtained, like that of antimony, by heating minutely divided bismuth with 5 times its weight of concentrated sulphuric acid.

SULPHATE of CADMIUM. Colourless, very efflorescent, very soluble, crystallizing in prisms with a rectangular base, which contain much of the water of crystallization. Heat decomposes it, making it pass to the state of a sub-sulphate. The sulphate of cadmium is obtained directly. It consists of 100 parts of acid, 161·12 of oxide.

SULPHATE of CERIUM. Sulphuric acid can combine with the protoxide and deutoxide of cerium. The *proto-sulphate* is white, of a sugared taste, soluble in water, and susceptible of being crystallized. It is obtained directly. The *deuto-sulphate* is in orange-coloured acicular crystals, some of which are of a citron yellow. It is obtained by heating the deutoxide of cerium with weak sulphuric acid, and evaporating the liquor.

Sulphate of Cinchonine. According to M. Baup, there are two sulphates of cinchonine, a neutral and an acid sulphate.

The first is formed of Cinchonine, . .	39
Sulphuric acid, .	5
Water, . . .	2·25,

or, 1 atom of cinchonine, 1 atom of acid, and 2 atoms of water.

The second is formed of Cinchonine, . .	39
Sulphuric acid, .	10
Water, . . .	9,

or, 1 atom of cinchonine, 2 atoms of acid, and 8 atoms of water.

The *neutral sulphate* is crystallized in rhomboidal prisms; it is soluble in 54 parts water at the ordinary temperature, and in 11½ parts of alcohol. It is obtained by a direct process. The *acid sulphate* is colourless, unalterable by the air, becomes efflorescent if the temperature is a little elevated, crystallizes in octoedrons with rhomboidal bases. It is soluble in half its weight of cold water and in its weight of alcohol, but is insoluble in ether. It is prepared by adding acid to the neutral sulphate, and evaporating the solution to a pellicle.

Sulphate of Chromium. Its existence only is ascertained.

Sulphate of Cobalt. A rose-coloured salt, susceptible of crystallizing in rhomboidal prisms, terminated by dihedral summits. It dissolves easily in cold water; its solution reddens the tincture of litmus, and gives with ammonia a precipitate soluble in an excess of alkali. The sulphate of cobalt is obtained by treating with sulphuric acid one of the oxides of the metal. The protosulphate is that which always forms.

Sulphate of Copper. (*Sulfate de Cuivre.*) The deuto-sulphate alone exists. It has a very styptic taste; is soluble in 4 parts of cold water and 2 parts boiling water, crystallizes in prisms with an oblique base; its crystals contain a large quantity of the water of crystallization, which gives them a beautiful blue colour. Exposed to the air, they become slightly efflorescent, and their surface appears whitish; when dried entirely by heat, they are white. They melt easily in their water of crystallization, and of course cannot become white till having been thus fused. When heated in a crucible with charcoal, it decomposes, and the metal is reduced. Its solution is precipitated by potash and soda; ammonia forms with it a greenish blue precipitate, which dissolves in an excess of alkali and forms a liquid of a beautiful blue, which the ancients called *celestial blue.* Sulphuretted hydrogen forms with it a dark brown precipitate. The ferro-cyanide of potassium precipitates it crimson, and the simple cyanide yellow. Iron and phosphorus decompose it, and become covered with a coat of metallic copper. The water of barytes precipitates it a bluish white, the precipitate is formed of the sulphate of barytes and the hydrated oxide of copper.

The sulphate of copper is seldom found crystallized in nature; this sulphate is common in the waters of the galleries of mines which contain pyrites of copper; it is sometimes found in such quantities as to be used for the extraction of copper; for this purpose the waters are collected and evaporated. This is called the *copper of cementation.* Large quantities of copper are obtained by roasting ores which contain sulphuret of copper; the most common method, and that by which this metal is obtained in its purest state, is by extracting it from the sulphuret of copper by roasting. This salt is of use in medicine and in the arts. It consists of 100 of acid and 99·126 of base.

Sulphate of Copper Ammoniacal. This salt is of a beautiful blue colour, it is distinguished from the sulphate of copper, 1st, by its ammoniacal odour; 2d, by its property of greening the infusion of violets; 3d, by the green precipitate which it gives with solution of the deutoxide of arsenic; this precipitate which is the arsenite of copper is very abundant, and appears immediately, while the deutoxide of arsenic with the sulphate of copper, does not furnish an evident precipitate until 20 or 25 minutes have elapsed. (*Orfila.*)

Sulphate of Gold. (*Sulfate d'Or.*) Pelletier observed that the deutoxide of gold might be dissolved in concentrated sulphuric acid; but as these two bodies have little affinity, if water is added to the liquid, sufficient heat is produced to reduce the gold, which precipitates in a black powder.

Sulphate of Glucina. A sugared salt which attracts humidity from the air, is very soluble in water, crystallizes, but with difficulty, in acicular prisms. It is prepared by a direct process.

Sulphate of Iron. (*Sulfate de Fer.*) Sulphuric acid combines with three oxides of iron; but according to Berzelius, there exist but the proto and trito-sulphates. He regards the deuto-sulphate as a compound of the two others. It is certain that by pouring an alkali into its solution, it forms a precipitate of tritoxide. If this precipitate is separated, and another precipitate is made with the same substance as before, the precipitate will then be almost wholly formed of the protoxide. Thus Berzelius considers the deutoxide of iron, as a *ferrate of iron*, or a compound of the protoxide and the tritoxide of the same metal.

The *proto-sulphate* is usually in the form of rhomboidal transparent crystals, of a beautiful green colour, and a very styptic taste. Exposed to the air, it becomes efflorescent, and its surface covered with ochre-like spots, which are the sub-trito-sulphate. It is soluble in 2 parts of cold water. Its solution is green, and soon decomposes; when left in the air it becomes red, giving a yellow precipitate, of the sub-trito-sulphate. Its colour is owing to the trito-sulphate which it contains, and which is formed by the absorption of oxygen from the air. The proto-sulphate of iron owes its colour to its water of crystallization, of which it contains $\frac{45}{100}$ of its weight; for if deprived of this by dissication, it becomes entirely white. Owing to the great quantity of water ot crystallization, by heating this sulphate suitably, a certain quantity of very concentrated sulphuric acid may be obtained, which is known by the name of "*Sulfurique glacial de Nordhausen.*" The residuum is the tritoxide of iron.

The solution of the proto-sulphate of iron, can absorb a certain quantity of the deutoxide of nitrogen, which is disengaged by heat; this same solution is not precipitated by sulphuretted hydrogen, but by the ferro-cyanide of potassium, forming a white precipitate, which immediately becomes blue by contact with the air. Chlorine produces the same effect; and the simple cyanide of potassium causes an orange precipitate. This sulphate is seldom found in nature in a solid state, but as the sulphuret of this metal is very abundant, and is easily changed by contact with the air to a proto-sulphate, this salt on account of its solubility is often found in solution in waters flowing in mineral regions. As this sulphate brings a low price, it is seldom obtained by the expensive method of evaporating these waters, but generally by exposing to the air the pyrites or the sulphuret of iron, which decomposes gradually. This salt is used in dyeing; it consists of 100 of acid and 87·836 of base.

The *deuto-sulphate* is prepared by treating the deutoxide of iron with weak sulphuric acid, at the same time avoiding access of air. It is soluble in water; the solution at first easily absorbs oxygen from the air, and passes to the state of a trito-sulphate. It is not precipitated by sulphuretted hydrogen, but the ferro-cyanate of potassium produces with it a clear blue precipitate, and the simple cyanide an abundant bluish green precipitate.

The *trito-sulphate*, is of an orange colour, styptic like the preceding, reddens the tincture of litmus, is soluble in water, and has never been made to crystallize. An excess of sulphuric acid increases its solubility, and renders it almost white; an excess of oxide renders it yellow. If, when evaporated to dryness, an attempt is made to redissolve it in water, it changes to an insoluble sub-sulphate, and a soluble acid sulphate, which remains in the liquor. Sulphuretted hydrogen forms a yellow precipitate of sulphur in the solution of the trito-sulphate of iron. The ferro-cyanate of potassium produces with it an abundant, deep blue precipitate, while the simple cyanide scarcely forms any. This salt is obtained by treating the hydrated tritoxide of iron with sulphuric acid.

SULPHATE of LEAD. (*Sulfate de Plomb.*) A white salt, very heavy, insipid, insoluble, volatile in the air, at a high temperature. It is little soluble in an excess of acid; but dissolves readily in hydro-chloric acid. When heated with charcoal, carbonic and sulphurous acids are disengaged, and a sub-sulphuret is formed. The sulphate of lead exists in nature; it is found in crystals, of which the prevailing form is the octoedron more or less truncated; these crystals are sometimes transparent, isolated, but more commonly collected in a crystalline mass resembling the sulphate of barytes; from the sulphate it may be distinguished by its forming a black spot when brought in contact with sulphuretted hydrogen, and in giving with the blow-pipe a metallic globule. It is obtained by pouring a solution of the sulphate of soda into a solution of the acetate of lead. It consists of 100 of acid and 278·89 of the protoxide of lead.

Sulphate of Lime. (*Sulfate de Chaux.*) *Gypsum. Plaster of Paris.* Without colour when pure, soluble in 300 parts of cold water, of course more soluble than lime. Exposed to the action of fire, it loses its water of crystallization, and fuses in a white enamel. It has much affinity for water, for if after losing by heat its water of crystallization, it is exposed to the air, it absorbs that of the atmosphere without changing its state.

The sulphate of lime, or gypsum (*gypse*) is abundant in nature; when it does not contain water, it is called *anhydrous.* It is usually found crystallized, fibrous, compact, &c. Its crystals are upright quadrangular prisms, they have a peculiar tendency to arrange themselves in groups, and round their angles. In the fibrous varieties, it has been remarked that the fibres are usually perpendicular to the side of the veins which contain them. The compact sulphate of lime is found in great quantities in the environs of Paris; hence its name. It commonly offers a pseudo-regular structure, and seems like the basalts, to divide into large prisms. This last variety is chiefly used as a plaster stone. The white crystallized sulphate of lime is usually pure enough for all practical purposes, but a still purer sulphate may be obtained by the direct combination of lime, and sulphuric acid.

Sulphate of Lithium. White, very sapid, susceptible of crystallization in irregular masses, very soluble in water, and unalterable by the air. It fuses with difficulty. When treated with sulphuric acid it forms an acid sulphate less soluble in water than the neutral sulphate, but which fuses more easily. It can form with the acid sulphate of alumine, a double salt analogous to alum, and which like that crystallizes in octoedrons, sometimes in in dodecahedrons. The sulphate of lithium is prepared by a direct process. It can also be obtained by peculiar processes from the ores which contain the oxide of lithium. The neutral sulphate of lithium is composed of 68·41 of acid to 31·59 of the base.

SULPHATE of MAGNESIA. In taste it is similar to that of the sulphate of soda, though less bitter. It was formerly called *sal catharticus amarus*, or bitter cathartic salt. It is now known by the name of Epsom salt, being furnished in considerable quantity by the mineral waters in that place; it is sometimes called *Sedlitz* salt, from a village in Bohemia which also contains mineral waters strongly impregnated with it. It is white, very soluble in water, crystallizes in 4-sided prisms, terminated by points with 4 faces. It effloresces in the air, fuses in its water of crystallization when exposed to heat, but does not experience the igneous fusion. The neutral carbonates of potash and soda do not precipitate this sulphate, but if the mixture is heated, a portion of carbonic acid is disengaged, and a precipitate is formed. The sulphate of magnesia is in commerce often imitated by the sulphate of soda whose crystallization has been disturbed; the appearance and even the taste may deceive, but the mistake can be discovered by pouring into the solution either potash or soda, which precipitates the sulphate of magnesia, but does not affect the sulphate of soda.

The sulphate of magnesia exists in the waters of many springs, in so great quantities as to give them a very bitter taste and strong medicinal properties. It may be obtained by evaporating, purifying, and crystallizing these waters. According to Gay-Lussac, 17·799 parts of the sulphate of magnesia contain,

Acid, . .	5·790,
Magnesia, .	2·855,
Water, . .	9·154.

This salt is of important use in medicine.

SULPHATE of MANGANESE. Sulphuric acid forms two salts with the oxides of manganese. The *proto-sulphate* is white, of an astringent and bitter taste, susceptible of

ing rhomboidal crystals, very soluble, decomposable
eat. It is obtained by heating in a crucible a paste
e peroxide of manganese and sulphuric acid; from
mixture is obtained the sub-proto-sulphate and the
ral sulphate. They are separated by water. The
ulphate always exists with excess of acid; it is red,
mposable by water, which unites with its sulphuric
It is obtained by treating the per-oxide of man-
se with concentrated sulphuric acid. The *deuto-*
ate does not exist; sulphuric acid changes the deut-
e of manganese into a protoxide which dissolves,
the deutoxide which is precipitated.

LPHATE of MERCURY. The *proto-sulphate* is white,
rulent, insipid, insoluble in water, soluble in excess
id. It is obtained by decomposing the proto-nitrate
ercury with the sulphate of soda. The *deuto-sulphate*
also be obtained by double decomposition, by em-
ing the deuto-nitrate of mercury. It may also be
ared by treating in a retort mercury and sulphuric
; one part of the acid is decomposed, oxidates the
l, and the remainder is disengaged in the state of
urous acid; the other unites to the oxide formed,
ucing a white mass, which is the deuto-sulphate of
ury. If this mass is washed with boiling water, it
ges to a colourless acid deuto-sulphate, which re-
s in solution, and a sub-deuto-sulphate which pre-
ites in a yellow powder. This powder, washed and
, was formerly known in pharmacy by the name of
h mineral. The acid sulphate may be employed in
reparation of the deuto-chloride of mercury.

LPHATE of MOLYBDENUM. Its existence only is
n.

LPHATE of MORPHINE. A salt having a very bitter
, soluble in water, and susceptible of crystallizing in
radiated needles. It can unite to an additional

quantity of acid and forms an acid sulphate. It is obtained by a direct process.

Sulphate of Nickel. A beautiful green salt, of a sugared and astringent taste. It effloresces in the air, dissolves in three parts of cold water, crystallizes in rhomboidal transparent prisms, which contain 45 for 100 of the water of crystallization, easily passes into the aqueous fusion. It is obtained directly, and consists of 47·8 of acid and 52·0 of base.

Sulphate of Platina. Of an orange yellow colour, a styptic taste, reddens litmus, is very soluble in water, crystallizes with difficulty. Like all salts whose metals have little affinity for oxygen, it easily decomposes by heat and the metal is set free. The sulphate of platina can form double salts with the sulphates of potash, soda, and ammonia. It is obtained by treating the sulphuret of platina with nitrous acid.

Sulphate of Potash. A white salt of a bitter taste, which crytallizes in 6-sided prisms, terminated by pyramids with 6 faces. It is soluble in 12 or 15 parts of cold water and in 5 parts of boiling water. It contains no water of crystallization, but a little water of interposition, which gives it the property of decrepitating when exposed to the action of heat; it is unalterable by the air. This salt is employed in medicine, but not so much now as formerly, when it was known as the *arcanum duplicatem, sal polychrest, vitriolated tartar*, &c.; its composition long remained a secret. Tarquinius obtained it by decomposing the sulphate of iron with the sub-carbonate of potash. It is prepared directly by uniting potash with sulphuric acid; but is more frequently obtained from the residues in the manufacture of nitric acid, these are entirely composed of the acid sulphate of potash; the excess of acid is saturated, not with potash which is more extensive than the sulphate, but with lime; water being added, it is filtered and evaporated, and crystals of the sulphate of potash are obtained. This salt consists of acid 100 and base 117·996. It is easy to distinguish a solution of the sulphate of potash from a solution of the sulphate of soda, by testing them with tartaric acid or the chloride of platina; the solution of the sulphate of soda will not be affected by either of these substances, while that of the sulphate of potash will give with tartaric acid a white, and with the chloride of platina a yellow precipitate.

Sulphate of Potash (Bi.). This salt was discovered by Ronelle; it crystallizes in needles, and sometimes in 6-sided prisms; its taste is acrid; it reddens the vegetable blues; is soluble in 2 parts of water at 60°, and in much less of boiling water; it melts readily, becoming opaquely white on cooling. It is usually obtained in the process for nitric acid, and is not used except to form the sulphate. It contains two proportions of sulphuric acid, and one of potash.

Sulphate of Quinine. A very bitter, white salt, susceptible of crystallizing in fine pearly needles, which collect in light masses. This salt becomes luminous at the temperature of boiling water. It is little soluble in water, but becomes very much so, by the addition of a quantity of sulphuric acid; this forms an acid sulphate. The science of medicine is indebted to Pelletier and Caventon, for the discovery of this important and valuable substance, one of the most precious of the *Materia Medica.* The sulphate of quinine exists united to a small quantity of kinic acid in the yellow quinquina (*Cinchona officinalis of Linnæus*). It is obtained by boiling twice for a quarter of an hour, the powdered quinquina bark in a sufficient quantity of water; 1 ounce of sulphuric acid to a pint of water is then added. These decoctions which contain the sulphate of quinine, are united, saturated by lime, and filtered; the deposite on the filter being well dried, is then heated with alcohol to 97°; the liquor is left to cool and deposite, then decanted, and the residue treated with a new quantity of alcohol; this operation is again repeated, and continued until the alcohol shows by being destitute of a bitter taste, that it no longer holds any of the quinine in solution; all these liquors are then united and distilled; in the distilling vessel will remain a thick blackish substance; this is quinine. To form the sulphate, the quinine thus obtained, must be boiled in water acidulated by sulphuric acid; this dissolves it entirely; the boiling liquor is then filtered, and on cooling, deposites a coloured sulphate of quinine; this is purified by new crystallizations, and by being treated with animal charcoal.

When little crystalline scales are observed in the boiling liquor, it should be filtered, as it will then on cooling, form a solid mass. The filters which are used, should first be washed in acidulated water. The sulphate of quinine should be dried with a moderate heat, and between sheets of paper, that it may not be coloured by the air.*

Sulphate of Silver. (*Sulfate d'Argent.*) A white salt of a metallic taste, little soluble in water, but becomes more so by an excess of acid. Exposed to the action of fire, it first melts, then decomposes. Like most of the compounds of silver, it is very soluble in ammonia, and forms a white precipitate with muriatic acid. It is obtained by decomposing a solution of the sulphate of soda, by a solution of the nitrate of silver. It can also be obtained by a direct process.

Sulphate of Soda. (*Sulfate de Soude.*) Is also called Glauber's salts, in honour of the chemist by whom it was discovered; the discovery was made in examining the residues in the preparation of muriatic acid. It is a colourless bitter salt, susceptible of forming very large crystals, which are six-sided prisms, terminated by summits with two faces, and containing $\frac{58}{100}$ of the water of crystallization. It effloresces very soon in the air. Gay-Lussac made some curious experiments upon its *solubility in water;* the result of them is, that at the temperature of 92°, water dissolves its greatest proportion of the salt, and that with either more or less heat, it dissolves less. Water at 92° dissolves half its weight, and at 32° but one-twentieth of its weight, and at 212° about the same as at 32°. It often happens that its solution, when standing entirely undisturbed, will not crystallize, though upon being slightly agitated, crystallization will soon take place. It is prepared in great quantities by decomposing the chloride of sodium (common salt) by sulphuric acid. The sulphate of sodium consists of 100 of acid and 78·187 of soda. This salt is very useful in medicine; it is used in the arts for the preparation of artificial soda, and for purifying the pyro-ligneous acid.

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* The authors add in a note that while their work was in press, they had learned that a pharmacian at Toulouse, had discovered the quinine in all the species of Cinchona, it being in all cases found combined with kinic acid.

SULPHATE of STRONTIAN. (*Sulfate de Strontiane.*) A white, insipid, and inodorous salt, scarcely soluble in water, yet more soluble than the sulphate of barytes, since it dissolves in 4000 parts of water; it resembles the sulphate of barytes in all its properties; it has, like that, a density of 4. It is found in nature in different situations, sometimes in regular crystals of rhomboidal prisms, like those of the sulphate of barytes, except that the angles are different; the faces of the point which terminates the crystals of strontian, form an obtuse angle with the axis of the prism, while the faces which terminate the crystals of the sulphate of barytes, present an acute angle. The sulphate of strontian is also formed in little fibrous masses, usually of a clear blue, from which it has received the name of *celestine;* it is often found in compact masses, containing a little carbonate of lime. It is not, like the sulphate of barytes, found in veins, but almost always in beds. The sulphate of strontian is used for obtaining strontian; this sulphate may be procured artificially, by pouring a solution of the sulphate of soda into the solution of a salt of strontian.

Sulphate of Tellurium. (*Sulfate de Tellure.*) Colourless, soluble in water, is easily decomposed by caloric. It is obtained by a direct process.

Sulphate of Tin. (*Sulfate d'Etain.*) Tin has little tendency to form combinations with acids; this is perhaps owing to the density of its oxide; yet by treating this metal with concentrated sulphuric acid, a sulphate is obtained which presents nearly the same physical characters as the sulphate of barytes, and which like that dissolves in very small quantities in sulphuric acid; but if instead of proceeding in the manner above described, concentrated sulphuric acid is poured into a solution of the proto-chloride of tin, hydro-chloric acid is disengaged, and a flaky precipitate formed, which can dissolve in water and crystallize in acicular prisms by a careful evaporation. If this new sulphate, by aid of heat, is treated with a new quantity of sulphuric acid, it passes to the state of an acid deuto-sulphate, which remains in the liquor without crystallizing.

Sulphate of Titanium. (*Sulfate de Titane.*) Colourless, uncrystallizable, always contains a small quantity of the sulphate of potash, provided that the oxide of titanium is employed in its preparation, which is itself prepared through the agency of potash.

Sulphate of Thorina. (*Sulfate de Thorine.*) A white salt, of an astringent taste, and soluble in water. On evaporating its solution, crystals without colour and unalterable by the air are obtained; but if left to itself, the solution in time deposites an insoluble sub-sulphate, and the liquor contains an acid sulphate.

Sulphate of Uranium. The proto-sulphate exists, but is scarcely known. The deuto-sulphate is yellow, acid, very soluble in water; it crystallizes, but with difficulty, in short prisms, containing 12 parts in 100 of the water of crystallization. It is obtained by heating the deutoxide of uranium with diluted sulphuric acid.

SULPHATE of YTTRIA. A white salt, of a sugared taste, soluble in 40 parts of cold water, susceptible of crystallizing; it is obtained by treating yttria with diluted sulphuric acid.

SULPHATE of ZINC. A white salt, of a sharp and styptic taste; it is obtained in granular masses, resembling sugar, but crystallizing in four-sided prisms, terminated by points, with four faces; it effloresces in the air, fuses easily in its water of crystallization, of which it contains 36 parts in 100. It is often covered with ochre-like spots, which indicate that it is rendered impure by the presence of iron. It is soluble in 3 parts of cold water, and in a less quantity of boiling water; the solution reddens the tincture of litmus, and a precipitate is formed by alkalies which redissolve the precipitate if added in excess. This precipitate is greenish white when the common sulphate of zinc is used, but perfectly white when pure sulphate of zinc is employed. The ferro-cyanate of potassium produces a blue precipitate with the sulphate of zinc of commerce; this precipitate is white when the sulphate is pure. The alkaline hydrosulphurets form with it a blackish deposite; this is whitish when the salt is pure. The chromate of potash forms an orange precipitate; an infusion of nutgalls forms no precipitate, unless other sulphates are in solution. The sulphate of zinc is employed in medicines; it is obtained pure by treating zinc with diluted sulphuric acid. That which is used in commerce is obtained by roasting the sulphuret of zinc; but as this sulphuret always contains some foreign sulphurets, this sulphate is not pure. It can be purified by boiling it with the oxide of zinc, which decomposes the sulphates of iron and copper which are the most common substances by which the sulphate of zinc is adulterated. This salt consists of 100 of acid, and 100·655 of base.

Sulphate of Zirconium. White, insipid, pulverulent, very soluble in water; it is obtained by double decomposition.

Sulphates (Hypo.) (*Hypo* from the Greek *upo*, less, the hypo-sulphates containing less oxygen than the sulphates.) The hypo-sulphates when exposed to the action of heat are changed into neutral sulphates and sulphurous acid. These sulphates do not readily absorb oxygen from the air; they are all more or less soluble in water. Sulphuric acid poured into these solutions takes the place of the hypo-sulphuric acid, and the latter remains in the liquor; but if this acid is added to a hyposulphate without any water, the acid is decomposed, and sulphurous acid and a sulphate are formed. The hyposulphates are prepared directly, except that of barytes and some others. In these salts the quantity of oxygen of the oxide is to the quantity of the acid as 1 to 9.

Sulphites. (*Sulfites.*) They resemble the sulphates in their properties; but as sulphuric acid has great affinity for bases, and as combinations formed with this acid are very permanent, the sulphites easily absorb oxygen, and pass to the state of sulphates; this takes place at the ordinary temperature, when they are exposed to contact with the air, and still more readily occurs when they are treated with nitric acid; this acid yields to the sulphites a portion of oxygen, changing them to sulphates, and becoming itself a deutoxide of nitrogen; thus by heating a sulphite whose base has much affinity for sulphuric acid, as magnesia and soda, the sulphite will leave a portion of sulphur, and pass to the state of a sulphate with excess of base; if it is a sulphite with excess of acid, there will also be a disengagement of sulphurous acid; but if the oxide has little affinity for the acid, the latter will escape, and the metal will be reduced. Many acids decompose the sulphites at the ordinary temperature, and disengage sulphurous acid; all the sulphites, except those of potash, soda, and ammonia, are insoluble in water.

The insoluble sulphites are obtained by double decomposition; those which are soluble are obtained by passing a current of sulphurous acid over a portion of potash, soda, or ammonia. This sulphurous acid is prepared by heating in a matrass weak sulphuric acid with small pieces of wood; sawdust should not be used, because that determines immediately the formation of too great a quantity of sulphurous acid, which may occasion the bursting of the matrass. In the sulphites, the quantity of oxygen of the oxide is to the quantity of the oxygen of the acid as 1 to 2, and to the quantity of acid as 1 to 4·48. In the neutral sulphates, the quantity of oxygen of the oxide is to the quantity of oxygen of the acid as 1 to 3. Thus a sulphite can by absorbing oxygen pass to the state of a sulphate without changing its state of saturation.

Sulphite of Ammonia. (*Sulfite d'Ammoniaque.*) A colourless salt, of a fresh and pungent taste, soluble in its weight of cold water, and in a less quantity of boiling water. Its solution easily absorbs oxygen from the air, and becomes a sulphate; if the solution, without being thus exposed to the air, is submitted to evaporation, crystals of the sulphite are obtained; these are 6-sided prisms terminated by points with 6 faces, often truncated. A very volatile acid sulphite is obtained by decomposing with heat the common sulphite.

Sulphite of Lime. (*Sulfite de Chaux.*) White, pulverulent, insoluble, absorbs oxygen from the air when boiled with water and occasionally agitated during the boiling. It is obtained by double decomposition.

Sulphite of Potash. (*Sulfite de Potasse.*) White, susceptible of crystallizing in acicular prisms which decrepitate when exposed to the action of caloric. It is very soluble in water, dissolving in its weight of cold water. It is prepared by a direct process.

Sulphite of Soda. (*Sulfite de Soude.*) Less soluble than that of potash, crystallizes more easily. It is obtained, like the sulphite of potash, by a direct process.

Sulphites (Hypo.) *Sulphuretted sulphites.* What has been discovered with respect to them is chiefly owing to the labours of M. Herschell. They are salts resembling the sulphites; they however decompose less easily; exposed to the action of fire, they are all destroyed, though at different temperatures; those which have much affinity for oxygen absorb this gas, disengaging a part of their sulphur, and becoming sulphates; if the sulphate formed is decomposable by heat, a sulphuret or even an oxide may be formed; but when the metal has little affinity for oxygen, the hypo-sulphurous acid decomposes into a sulphurous acid which is disengaged, and sulphur which often forms a sulphuret with the metal. Many of the hypo-sulphites dissolve in water, and can be crystallized by a careful evaporation. Most acids decompose the solutions of these sulphites, disengaging sulphurous acid, precipitating sulphur, and forming a new salt, which, if it is insoluble, precipitates with the sulphur, or if soluble, remains in the water. The hypo-sulphites combine easily among themselves, and form double salts. It appears that hypo-sulphuric acid can combine in different proportions with salifiable bases; for there are hypo-sulphites in which the quantity of oxygen of the oxide is to the quantity of oxygen of the acid as 1 to 2, and others in which the quantity of oxygen of the oxide is to the quantity of oxygen of the acid as 1 to 3, in some even as 1 to 1. Many hypo-sulphites are obtained by boiling the sulphites with sulphur pulverized; they may be obtained by double decomposition, or by passing a current of sulphurous acid over an alkaline hydro-sulphuret.

Sulphites Sulphuretted. See *Sulphites* (*Hypo.*)

Sulpho-Cyanides. See *Cyano-Sulphurets.*

Sulphur. (From the Greek *sul* and *pur*, fire, so called from its great combustibility. In French, *Soufre.*) It is an undecomposable body, solid, of a fine yellow colour, insipid, inodorous, very brittle; its specific gravity is 7·99. It gives off an odour by rubbing, and may in this manner be heated sufficiently to break with a crackling noise; by rubbing also, like amber, it discovers the resinous electricity. It is a bad conductor of the electric fluid. It fuses at 218°. If the liquid part is turned off when the outer crust is solidified, acicular crystals are obtained. The native crystals are octoedral with rhomboidal bases, often translucid, and which then exhibit double refraction like the rhomboidal crystals of carbonate of lime.

Sulphur volatilizes at a high temperature, and sublimes in the receiver; if heated in the air or in oxygen gas, it forms sulphurous acid, exhibiting in the oxygen a white flame, and in atmospheric air a blue flame. It combines also with oxygen to produce sulphuric, hyposulphuric, and hypo-sulphurous acids. It also forms combinations with most simple metallic and non-metallic bodies. Water has no action upon it, but it is soluble in the essential and fixed oils, the per-carburet of sulphur, and crystallizes by evaporation. In contact with different chemical compounds, and by the aid of heat, it acts like a deoxygenating substance, producing sulphurous acid. Sulphur is very abundant in nature. Humboldt found large masses in the Cordilleras. It is found very abundant in volcanic countries, disseminated in earthy substances, sometimes in beautiful translucid crystals, at others it forms stalactites, or concretions, in stagnant waters. It enters into combinations with hydrogen under the names of sulphurets and sulphates; it exists in some vegetable and animal substances; as the cruciform plants and in eggs. Sulphur being volatile and usually combined with substances which are not so, its extraction is very easy. It is obtained from the earths by placing the ore in large covered crucibles, which are heated in a galley-furnace. The sulphur which is obtained is purified by a new distillation; this is performed in a large caldron of cast iron, which is connected with a lateral chamber. If the operation is suspended at the end of eight or ten hours, the sulphur has not time to form a solid mass, and the *flour*, or *flowers, of sulphur* are obtained; if the operation is continued, the sulphur collects in masses upon the floor of the chamber; it is then, in a melted state, drawn out by means of a stop-cock, and passes into conical wooden moulds; this is called brimstone, which is always seen in small rolls. Sulphur may be extracted from the sulphuret of iron by heating it sufficiently in cast iron vessels. Sulphur has numerous uses: it is employed in medicine; very great quantities are consumed in the preparation of sulphuric acid and gunpowder; it is burned for the preparation of sulphurous acid, for the bleaching of silk, straw, and Leghorn hats, and for sulphurous vapour-baths, &c.

SULPHUR GOLDEN of ANTIMONY. (*Soufre doré d'Antimoine.*) See *Sulphuret of Antimony.*

SULPHUR HYDROGENATED. (*Soufre Hydrogéné.*) See *Hydruret of Sulphur.*

SULPHUR OXYMURIATED. See *Chloride of Sulphur.*

SULPHURETS. (*Sulfures.*) Combinations of sulphur with combustible bodies. Of all combinations which combustible bodies can form among themselves, there are in nature none which perform a more important part than the sulphurets. A great number exist already formed, and chemistry can create still more. It appears certain that a metal, for example, can combine with sulphur in as many proportions as it can combine with oxygen; and that there exists even as simple relations between the different quantities of sulphur which it can contain, as between the quantities of sulphur and the quantities of oxygen which it would contain in the state of an oxide. There exist then the proto, deuto, and trito sulphurets as there are protoxides, deutoxides, and tritoxides. Berzelius, taking for an example the numerous combinations of potassium and sulphur in definite proportions, supposed there might be as great a number of sulphurets of other substances; but as no other substance has so great an affinity for sulphur as potassium, it happens that either these sulphurets do not form, or if they do, are immediately destroyed. Thus Berzelius obtained a sulphuret of the colour of blood, composed of 1 atom of lead and 10 atoms of sulphur; but this combination was soon destroyed, and changed spontaneously into an ordinary sulphuret and sulphur.

Not only are the sulphurets always formed in definite proportions, but those proportions are the same as those which exist in the sulphates; thus, if by any means a quantity of oxygen sufficient to acidify the sulphur to its *maximum*, and to carry the metal to the state of a protoxide, is added a proto-sulphuret, the result will be a neutral sulphate. The sulphurets can also combine among themselves, and form compounds in definite proportions; so that the quantity of sulphur of one is to the quantity of the sulphur of the other, in a given proportion; the same as in a salt, where the quantity of oxygen of the oxide is to the quantity of oxygen of the acid in a proportion uniform in all salts of the same kind, and in the same state of saturation. These combinations of the sulphurets are frequent in nature; when they exist in favourable circumstances, they often absorb oxygen, and become sulphates.

The physical properties of the sulphuret are too various to be generalized in description. We shall in this article consider only the manner in which they are affected by the action of caloric. It might perhaps be foreseen what would take place in this case, by considering the affinity of the metal for oxygen, and also by noticing the fact that if the metal has much affinity for oxygen, it has equally as great for sulphur by examining if the sulphur is at its *minimum* or *maximum* of sulphuration, and knowing the degree of heat to which the sulphurets ought to be submitted. If the operation is performed in a vacuum, some such as those of mercury and arsenic volatilize; others, as those of potassium and sodium, experience no alteration; those which are in the state of per-sulphurets, yield a portion of their sulphur, and pass to the state of proto-sulphurets, which an elevated temperature will not decompose if the metal have much affinity for oxygen, as iron; but will almost wholly decompose if the metal is one of those which, like gold, platina, &c. have little tendency to form or maintain combinations.

If the sulphurets are submitted to the action of heat in the air, those whose metals have much affinity for oxygen, absorb this gas, and form sulphates. This is the case with most of the sulphurets; but each requires a different temperature. Thus the alkaline sulphurets can become sulphates only at a high temperature, because these sulphates are undecomposable by heat; the case is very different with the other sulphurets which cannot pass through this transformation, but at a degree of heat inferior to that which is necessary to produce a decomposition of the sulphates which they form. If the proto-sulphuret of iron is slowly and moderately heated, the iron oxidizes, the sulphur passes to the state of sulphuric acid, and the proto-sulphate of iron is formed by the union of the new oxide of iron and the sulphuric acid. But if the same sulphuret is exposed to a high temperature, the sulphur not forming sulphuric acid, which is decomposed at a high temperature, is disengaged in the state of sulphurous acid, and the metal remains in the state of a tritoxide.

The sulphurets whose metals have little affinity for oxygen, act in the air as in close vessels; they decompose partially or wholly, and the metal is reduced. This decomposition of sulphurets whose metals are very oxidable, and their transformation into sulphates, often takes place, naturally or artificially, at the ordinary temperature. Water favours this change when it can dissolve the sulphate which is formed; it is probable that a part of the water is decomposed, and that its oxygen serves to burn the sulphur and the metal. As water dissolves the sulphate, it acts also by exposing and setting free the surface of the sulphur, and thus facilitating the access of oxygen. The remains of sulphurets of iron are found in nature, which have lost their sulphur, and whose metal has become oxidized; this fact appears the more remarkable, as this decomposition begins in the centre of crystals, while the exterior crust is still in the state of a sulphuret.

Nitric acid acts upon most of the sulphurets when they are in a sub-divided state; it yields to them its oxygen, which changes them to sulphates, and becomes itself a deutoxide of nitrogen. Many sulphurets exist in nature, in crystals, although in laboratories it is difficult to obtain them crystallized; the form of these crystals while they preserve their metallic lustre, is usually some modification of the cube; but when they do not possess this lustre, they vary more or less from the regular system of crystallization. Many of these sulphurets combine among themselves, and as has been observed, form compounds in definite proportions, according to laws analogous, to those which regulate the composition of salts; so that one of these sulphurets is always electro-negative in relation to the other, and represents the acid, while the electro-positive represents the base. Most of the sulphurets can be obtained by direct process, or by passing a current of sulphuretted hydrogen over the saline solution of metal, whose sulphuret is sought. Other methods of obtaining them will be pointed out under the head of alkaline sulphurets.

Sulphurets Alkaline. (*Sulfures Alcalins.*) This general name is given to combinations of sulphur with the metals of alkalies. As these sulphurets present characters which are peculiar to themselves, we have thought proper to treat of them in a separate article.

Since the discovery of potassium and sodium, it has been known that sulphur may be combined directly with these metals, forming sulphurets of peculiar properties. It has also for a long time been believed that sulphur could combine with the oxides of these metals, and form sulphurets of oxides; but late experiments by Berzelius have demonstrated that sulphur cannot combine with an oxidated body, and therefore that the sulphuretted alkalies do not exist, and that when a salifiable base took sulphur by the dry method, it became in part reduced, forming a metallic sulphate and sulphuret. Thus in fusing a mixture of sulphur and the sub-carbonate of potash, $\frac{1}{4}$ of alkali serves to form the sulphate, and the remaining $\frac{3}{4}$ lose their oxygen and combine with sulphur so as to form the sulphuret of potassium. Thus the preparation known by the name of *liver of sulphur*, is a compound of the sulphuret of potassium and the sulphate of potash. Sulphur, as has been seen, can reduce the oxide of potassium at a temperature not very elevated; but the reduction takes place much more easily, and the sulphuret forms with greater, facility by employing hydrogen and carbon as deoxygenating bodies.

Berzelius has obtained many sulphurets of potassium in definite proportions.

1st. The *proto-sulphuret* consists of 1 atom of potassium and 2 atoms of sulphur; it was formed by reducing the sulphate of potash by hydrogen.

2d. The *bi-sulphuret*, which consists of 1 atom of potassium and 4 atoms of sulphur, was formed by pouring at a red heat, the carbonate of potash, with a quantity of sulphur less than it could decompose.

3d. The *trito-sulphuret*, which consists of 1 atom of potassium, and 6 atoms of sulphur, was formed by heating slowly the preceding mixture, until it melted without ebullition or disengagement of gas.

4th. The *quadri-sulphuret* consists of 1 atom of potassium and 8 atoms of sulphur; this was formed by reducing the sulphate of potash by the sulphuret of carbon.

5th. The *quinto-sulphuret* consists of 1 atom of potassium and 10 atoms of sulphur; this was formed by fusing the carbonate of potash with an excess of sulphur, until carbonic acid was no longer disengaged.

Metals brought in contact with the alkaline sulphurets in a state of fusion, take from them a certain quantity of sulphur and form sulphurets; if they are in sufficiently great proportions, the metals can bring the different sulphurets of potassium to the state of a proto-sulphuret. In these double sulphurets, the number of atoms of the metallic sulphuret which is produced, is determined by the number of atoms of sulphur in the sulphuret of potassium.

The alkaline sulphurets, when in contact with water, dissolve without any disengagement of gas. Berzelius makes two suppositions as to the nature of these solutions; it is perhaps difficult to decide which comes nearer the truth:

1st. Whether the water is decomposed by the sulphur, when the combustible body is dissolved by the alkali, or by the radical of the alkali, when the metallic sulphuret is treated with water.

2d. Whether the metallic sulphuret dissolves in the water without being altered; and the sulphuretted hydrogen, which the acids drive from the solutions, forms but at the instant in which the potassium oxidizes, in order to unite to the acid.

According to the first of these hypotheses, the liquor contains potash and sulphuretted hydrogen; but this last body cannot be considered as formed of constant proportions of sulphur and hydrogen. It would be necessary to admit combinations of 2 atoms of hydrogen with 1, 2, 3, 4, and 5 atoms of sulphur, combinations which would constitute peculiar compounds, which that celebrated chemist was not able to isolate. He concluded, therefore, that the terms *hydro-sulphates*, and *sulphuretted hydro-sulphates* are less proper than those of *hydro-sulphurets*, *hydro-bi-sulphurets*, &c. But if it is admitted that the alkaline sulphurets are dissolved in water, without being decomposed, there would not then exist such a series of sulphurets of hydrogen; but when an acid (undecomposable by sulphuretted hydrogen) is poured into a solution of a sulphuret, the sulphuretted hydrogen which is produced, is formed by the presence of this acid, which decomposes a portion of water by its tendency to combine with the oxide formed. This effect takes place with the dry sulphuret, as well as the solution; Berzelius seems rather inclined to favour the latter theory. He does not adopt it exclusively for the sulphuret of potassium, which is deliquescent, but appears to adopt it for the sulphuret of calcium. He remarks that boiling water, poured upon a sulphuret of calcium, dissolves but a small quantity; that which is insoluble changes neither in colour nor composition. He preserved during some months, some sulphuret of calcium in a close flask, filled with water, yet this substance was not decomposed; now if this decomposition is really made by water, it appeared to him that it would of course have taken place, when even the hydro-sulphuret of lime which forms is little soluble in water, much more than in barium, calcium, manganese, &c., which decompose water and disengage hydrogen, although the oxides which they form are not soluble.

The solution of sulphuret of calcium which is obtained, is without colour; when evaporated in a vacuum over sulphuric acid, it deposites upon the sides of the vessel white crystals, which, when slightly heated, yield their water, and pass to the state of a sulphuret of calcium, like a salt with the water of crystallization, or like the double cyanides of iron with potassium, barytes, or lime. Berzelius thought it also probable that the sulphuret of calcium dissolves in water without undergoing any alteration, and combines with the water of crystallization only in being decomposed by water and changed to a hydro-sulphuret.

The solution of an alkaline sulphuret exposed to the air, gradually absorbs oxygen and passes to the state of a hypo-sulphite. But if the sulphuret is not at its highest point of sulphuration, there remains in the liquor a quantity of free potash, as much greater as the sulphuret is less sulphuretted. The acids destroy the solutions of the alkaline sulphurets as we have seen. If we admit the decomposition of water, and the formation of a hydro-sulphuret, the acid must take the place of the hydrosulphuric acid (sulphuretted hydrogen) which is disengaged; but if we admit the solution of the sulphuret without the decomposition of water, then it will be decomposed by the presence of the acid in the same quantity as potassium (supposing the solution to be that of sulphuret of potassium) is transformed into potash by its oxygen. Its hydrogen then will form with the sulphur, sulphuretted hydrogen, which disengages as it finds itself in the presence of an acid which has a still greater affinity for potash. Thus supposing the proto-sulphuret of potassium in solution in water and in the presence of an acid; it will happen that this sulphuret, composed of 1 atom of potassium and 2 atoms of sulphur, will decompose a quantity of water sufficient to yield 2 atoms of oxygen, which will combine with the potassium to form potash. As water is formed of 1 atom of oxygen and 2 atoms of hydrogen, these 2 atoms of oxygen combined with potassium to form potash, will have set at liberty 4 atoms of hydrogen, which will combine with 2 atoms of sulphur of the sulphuret of potassium to form sulphuretted hydrogen, which is disengaged since the potash is in the presence of an acid, for which it has greater affinity.

If instead of employing the proto-sulphuret, the bi-sulphuret, the tri-sulphuret, &c., are used, all containing the same quantity of potassium, that is, 1 atom, it is evident that the same changes as above described will take place; but as the quantity of water decomposed is always the same, the quantity of sulphuretted hydrogen produced will also be the same, and there will be consequently a deposite of sulphur as much greater, as the sulphur was in a higher state of sulphuration. When the alkaline sulphurets are prepared in the humid way, we may, as has been seen, admit the reduction of the alkali and the combination of the sulphur with its metal; or we may say that the water is decomposed, and that one part of the alkaline base unites to a compound of sulphur and hydrogen, while the other combines with the hydro-sulphurous acid which is at the same time produced. The solution in water of the proto-sulphuret of potassium is regarded by Berzelius as a sub-hydro-sulphuret, which he represents by the sign $\dot{K} + 2\,H^2\,S$ (K is the initial letter of *Kali*, which according to Berzelius is potash.[*]) When sulphur is digested in this solution, it dissolves, and by this means is obtained the sulphuret of potassium, at all the degrees until the solution contains 4 atoms of hydrogen and 10 of sulphur for 1 atom of potash, or $\dot{K} + H^4\,S^{10}$ which is the same combination as that formed when the sulphuret of potassium at the maximum, or the quinti-sulphuret, is dissolved in water. This chemist regards as a neutral hydro-sulphuret that which is formed of $\ddot{K} + 4\,H^1\,S$, or which contains a quantity of sulphurretted hydrogen, precisely double that contained in the sub-hydro-sulphuret. When pulverized sulphur is mixed in a concentrated solution of this neutral hydro-sulphuret, the result even at the ordinary temperature, is a violent effervescence, and a disengagement of sulphuretted hydrogen gas; the sulphur dissolves and the solution takes an orange colour. If sulphur continues to be added until the gas is no longer disengaged, the combination is obtained which contains the most sulphur, or $\ddot{K} + H^4\,S^{10}$; so that 8 atoms of sulphur expel 2 atoms of sulphuretted hydrogen, or half the hydro-sulphuric acid contained in the salt. The alkaline hydro-sulphurets have the property of dissolving a certain number of metallic sulphurets, viz. those of metals whose oxides are electro-negative, or can perform the part of acids, as the sulphurets of arsenic, tungsten, molybdenum, antimony, &c.; all are soluble in the hydro-sulphurets, and in the caustic alkaline sulphurets. Their solution in the last (except that of the sulphurets of antimony and titanium) is precipitated by the acids, without any disengagement of sulphuretted hydrogen, as they had in dissolving experienced no alteration.

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[*] For an explanation of these signs see the article *Signs Chemical*.

SULPHURET of ANTIMONY. (*Sulfure d'Antimoine.*) *Proto-sulphuret.* Of a bluish gray colour, shining, usually confusedly crystallized, and forming masses more or less voluminous, brittle and easily reduced to powder. Its specific gravity is 4·3. Exposed to fire, it fuses more easily than antimony, and is not decomposed at an elevated temperature. If heated in contact with the air, it absorbs oxygen, disengages sulphurous acid, and unless the temperature is too high it forms a sub-sulphate of antimony. The proto-sulphuret of antimony exists in ma-ture in the veins of different minerals, and sometimes itself forms important veins. It is found in crystalline masses, composed of interlaced acicular prisms, in the lamellar and compact state. Sometimes these crystals are rather separated, but they are always very fine, and united by their bases so as to form groups, in which may be observed crystals derived from the rhomboidal form. It often combines with other sulphurets, particularly those of silver and copper. It is composed of 27 parts sulphur and 73 of antimony, or 1 atom of antimony and 3 atoms of sulphur. This sulphuret can be prepared directly, but it is much easier to obtain it from ores. It is employed in the preparation of some active medicines.

Hydrated proto-sulphuret. Most chemists at present agree in regarding the *kermes mineral* as a proto-sulphuret of antimony, containing the quantity of water which would be necessary for transforming the metal to an oxide, and the sulphur to sulphuretted hydrogen; some chemists consider it as a hydro-sulphate. It is a beautiful red powder, insoluble in water, partly soluble in the alkalies; entirely soluble in hydro-chloric acid. It is obtained by melting in a crucible 2 parts of the sulphuret of antimony with 1 part of potash; the mass is cooled, pulverized, and boiled in 12 times its weight of water; the boiling liquor is filtered, and the kermes is deposited on cooling. This is the dry way; but the kermes obtained does not possess that fine colour which it does when prepared as follows: Dissolve 1 part of pure subcarbonate of soda in water, boil the solution, deprive it of air; add gradually 2⅔ parts of pulverized sulphuret of antimony, taking care to agitate the mixture. Boil for half an hour, and filter; the liquor is then cooled, and the kermes deposited. After this it is washed, dried by a gentle heat, and pressed. Soda is to be preferred to potash, giving a much finer colour, but why is not known.

Sulphuret of Ammonia Hydrogenated. (*Sulfure d'Ammoniaque Hydrogéné.*) *Hydro-sulphuret of ammonia.* It is a thick liquid, of a reddish brown colour, of an odour and taste very disagreeable. Exposed to the action of caloric, without access of air, it produces sulphur and a hydro-sulphate which volatilizes; when treated by water, the same products are obtained. This sulphuret is obtained by heating in a retort a mixture of lime, sulphur, and hydro-chlorate (muriate) of ammonia; a yellowish, very volatile liquor is formed, which condenses in a receiver. This liquid is transferred to a flask with its weight of the flowers of sulphur, of which it dissolves the greater part, becoming thick and coloured; this constitutes the hydro-sulphuret of ammonia. In this operation, the chlorine contained in the hydro-chlorate of ammonia, decomposes a portion of the lime, forming the chloride of calcium; the oxygen of the lime decomposed, combines with 1 part of sulphur, in order to form hypo-sulphuric acid, which unites to the portion of lime not decomposed; while the remainder of the sulphur, the hydrogen of the hydro-chloric acid, and the ammonia of the hydro-chlorate, unite to form a sulphuretted hydro-sulphate, which is saturated by being mixed with an excess of sulphur. This hydro-sulphuretted sulphate of ammonia (sometimes called sulphuret) was formerly called *Boyle's fuming liquor*, from the name of its discoverer, and from the circumstance of its exhaling thick white fumes.

Sulphuret of Arsenic. (*Sulfure d'Arsenic.*) Arsenic combines easily with sulphur, and by suitably heating different quantities of sulphur with the metal, a number of sulphurets may be obtained. It is however probable that these sulphurets are only mixtures of the proto and deuto sulphurets, in different proportions. The artificial sulphuret of arsenic is obtained by passing a current of sulphuretted hydrogen into a solution of the deutoxide of this metal; it precipitates in yellow flakes. It may also be obtained by sublimation, since the two bodies which compose it are volatile. It corresponds to the deutoxide of arsenic, and is therefore a deuto-sulphuret. It exists in nature. It is known by the name of *orpiment.* It is yellow, non-metalloid, but shining, lamellar, and flexible; it is seldom found crystallized, but usually in masses which divide parallel to the axis of an oblique rhomboidal prism, which is its primitive form. This lamellar state serves to distinguish it from the artificial orpiment, which is always compact; both consist of 39 parts sulphur to 61 arsenic, or of 1 atom of arsenic and 3 atoms of sulphur.

The *proto-sulphuret* or *realgar* can equally be obtained by artificial means, either by combining proper quantities of sulphur and arsenic, or by heating the orpiment or deuto-sulphuret. As it exists in nature, it is a red substance, without metallic lustre, compact, or sometimes in crystals more or less determinate, derived from an oblique rhomboidal prism. Its specific gravity is 3·3. It is formed of 30 of sulphur, and 70 of arsenic, or of 1 atom of arsenic and 2 atoms of sulphur. The sulphurets of arsenic being insoluble in water, are much less poisonous than the soluble compounds of this metal; these are easily known by the garlic-like odour which they give off when thrown upon burning coals, and on heating them with an excess of soap in a little glass tube, solid arsenic may be obtained.

Sulphuret of Barium. (*Sulfure de Barium.*) Of a grayish white, forming crystalline masses, soluble in water, and producing a colourless solution. Muriatic acid disengages much sulphuretted hydrogen from this solution, without giving place to any deposite of sulphur. It is very little altered by the air even by elevating the temperature. It can be burnt only by heating it with the nitrate of potash; the result is the sulphate of barytes. The chlorate of potash does not produce the same effect.

The sulphuret of barium is obtained by exposing the sulphate of barytes and charcoal to an intense heat. See *Alkaline Sulphurets.*

SULPHURET of BISMUTH. (*Sulfure de Bismuth.*) Of a yellowish or bluish gray, susceptible of crystallizing in needles, which cross and form masses similar in appearance to the sulphuret of antimony. It is very brittle, less fusible than bismuth, easily absorbs oxygen by the aid of heat, producing if the heat is not too great, sulphuric acid and a sulphate. This sulphuret is obtained by fusing sulphur with bismuth ; it seems difficult by this means to obtain it pure ; for the different analyses which have been made of it, have not given the same results. It exists in nature but in small quantities. It is yellowish, has a metallic lustre, crystallizes in rhomboidal acicular prisms. Its specific gravity is 6. It consists of 18 of bismuth, and 82 of sulphur, or of 1 atom of metal and 2 atoms of sulphur.

SULPHURET of CADMIUM. (*Sulfure de Cadmium.*) According to M. Stromeyer, this sulphuret is of a beautiful orange colour, fusible only at a white heat, susceptible of crystallizing by a careful evaporation in micaceous, transparent lamina of a fine yellow colour. Exposed to the action of heat, it becomes brown, afterwards crimson, and resumes its natural colour on cooling. It may be obtained by heating a mixture of sulphur and cadmium ; but can be procured more easily by precipitating a salt of this metal, by sulphuretted hydrogen, or reducing the oxide of cadmium by sulphur. It consists of 100 of cadmium, and 28·172 of sulphur.

SULPHURET of CALCIUM. (*Sulfure de Calcium.*) White, opaque, infusible, dissolves very sparingly in water ; it transforms itself into a sulphate of lime when exposed in a humid atmosphere ; it is, like the sulphate of barytes, obtained by treating the sulphate of lime with carbon at a very elevated temperature.

Sulphuret of Carbon. See *Carburet of Sulphur.*

Sulphuret of Cerium. (*Sulfure de Cérium.*) This sulphuret is scarcely known; the hydro-sulphuret of ammonia precipitates its solutions brown, but the precipitate passes to a deep green, as more of the agent is added; on heating it in contact with the air it burns, producing sulphurous acid, and giving the oxide of cerium for a residue.

Sulphuret of Chlorine. (*Sulfure de Chlore.*) See *Chloride of Sulphur.*

Sulphuret of Chrome. (*Sulfure de Chrôme.*) Little is known of it, except that it exists, and is obtained by heating a mixture of sulphur and the chloride of chrome.

Sulphuret of Cobalt. (*Sulfure de Cobalt.*) It may be obtained by heating a mixture of sulphur and the oxide of cobalt, but more easily through the medium of potash; it then forms a double sulphuret, of a yellowish white, which easily crystallizes, but decomposes with difficulty.

Sulphuret of Columbium. (*Sulfure de Columbium.*) As sulphur appears to combine with all metals, it is probable that a sulphuret of columbium does exist, though it has not been obtained.

Sulphuret of Copper. (*Sulfure de Cuivre.*) *Proto-sulphuret.* Solid, brittle, black, or of a deep gray, much more fusible than copper, easily absorbs oxygen from the air by the aid of heat, yielding different products according to the temperature. It is obtained by fusing copper and sulphur together; combination takes place on their inflaming; this inflammation is most intense when 8 parts of metal are combined with 3 parts of sulphur. The sulphuret of copper exists in nature, and appears in fragments of a steel gray colour, resembling that which is artificially obtained. Its specific gravity is about 5; it is sometimes found crystallized in forms derived from a regular hexahedral prism. It is composed of 20 parts of sulphur, and 80 of copper, or 1 atom of each of the constituents. It is found in combination with the sulphurets of antimony, silver, bismuth, tin, and particularly with the sulphuret of iron; this last combination is known by the name of *copper pyrites*, or pyritous copper. It exists in masses more or less voluminous, of a gold colour, sometimes iridescent. Its crystals, which are much more rare than those of iron pyrites, are derived from the tetrahedron. This substance, and the gray copper which seems to be a mixture of this pyrites with some other sulphurets, are considered as the two most important copper ores. The last often contains silver, probably existing in it as a sulphuret.

The *deuto-sulphuret* is little known; it may easily be procured by passing a current of sulphuretted hydrogen into the solution of a deuto-salt of copper.

Sulphuret of Gold. (*Sulfure d'Or.*) Is little known; by pouring the solution of an alkaline sulphuret into a solution of gold, a black precipitate is obtained, which appears to be a sulphuret. A precipitate is also obtained by heating a mixture of 3 parts of potash, 3 parts of sulphur, and one part of gold, and precipitating by an acid; the precipitate consists of 100 of metal and 24·39 of sulphur.

Sulphuret of Iodine. (*Sulfure d'Iode.*) By slightly heating a mixture of sulphur and iodine, a brilliant radiated mass is obtained, resembling the sulphuret of antimony and which easily decomposes. This is the sulphuret of iodine.

Sulphuret of Iridium. (*Sulfure d'Iridium.*) Is obtained by heating intensely a mixture of sulphur, muriate of ammonia, and iridium. A sulphuret is obtained which easily decomposes by contact with the air. According to Vauquelin, it consists of 100 of metal, and 33·33 of sulphur.

Sulphuret of Iron. (*Sulfure de Fer.*) By heating different proportions of sulphur and iron filings, a black sulphuret of iron is obtained; this is brittle and destitute of metallic lustre, and much more fusible than iron; its cohesion being less than that of natural sulphurets, it easily decomposes by the acids; the result of this decomposition is a protoxide of iron, and sulphuretted hydrogen, which is disengaged. The proportions of sulphur and of iron in this sulphuret vary in a peculiar manner, and render it probable that it is only a mixture of two sulphurets in uniform proportions. Mineralogists admit three species of sulphuret of iron; chemists admit but two, founded upon the proportion of their constituent principles.

The *proto-sulphuret*, or *magnetic sulphuretted iron* is of a yellowish, often a reddish brown; its fracture is rough; it is affected by the magnet. Its crystals are often hexagonal tables, sometimes approaching to the rhomboidal prism; it appears to belong to the primitive earths. *It is* composed of 37 parts of sulphur, and 63 of iron, or 1 atom of iron and 2 atoms of sulphur; but it is mixed with a certain quantity of per-sulphuret.

The *per-sulphuret*, also known by the name of *marcassite, martial pyrites*, &c., is of a brass yellow, and possesses metallic lustre. It gives off sparks when struck by steel, at the same time diffusing a sulphureous odour, which becomes still stronger on exposing the metal to the heat of burning coals. By the blow pipe this sulphuret is converted into a metallic globule, attracted by the magnet. Its specific gravity is from 4 to 4·7; it is susceptible of a high polish. Its primitive form may be the cube or octoedron, although it appears in several other forms. These pyrites often contain different substances, as arsenic, silver, gold, &c.; such as contain gold usually have the faces of their crystals striated. There exists a variety, which mineralogists regard as a distinct species; this is of a pale colour, sometimes approaching to steel gray.

It is not affected by the magnet. This variety passes more easily than the other to the state of a sulphate; and this change which often occurs in nature, also takes place in mineralogical collections, when the sulphuret is exposed to the air; it is very remarkable that this change commences at the centre and gradually extends to the outer parts of the mineral. This variety is chiefly used for obtaining the sulphate of iron; it is common in connection with argillite and beds of lignite. The other variety is one of the most abundant minerals; it is found in the primitive as well as the newest formations; it is often the only metallic substance which is found in veins of quartz. It is more rare in volcanic countries. Both varieties consist of 54 parts of sulphur, and 46 of iron, or 1 atom of iron, and 4 of sulphur. Every analysis has not given this proportion; sometimes the proto-sulphuret has been found in combination.

Sulphuret of Lead. (*Sulfure de Plomb.*) *Galena.* The *proto-sulphuret* is obtained by melting in a crucible, a mixture of lead and sulphur. Combination takes place with a disengagement of caloric and light; the result is, a brittle, shining sulphuret, of a dark bluish gray, much less fusible than lead. Exposed to a very elevated temperature, in contact with the air, it decomposes, giving rise to sulphurous acid, lead, and a sub-sulphate; a part of the latter volatilizes. It consists of 100 of the metal and 15·54 of sulphur. The sulphuret of lead exists in nature in great quantities, in masses of a lead gray metalloid, easily separated, and dividing parallel to the faces of the cube, which is its primitive form. This sulphuret contains the sulphurets of antimony, bismuth, and silver; that which contains the greatest quantity of this last, is in general the most confusedly crystallized, or offers very small crystalline faces. The miners call the variety *galène à petites facettes.* The natural sulphuret of lead consists of 13 parts of sulphur, and 87 of metal; or 1 of lead, and 2 atoms of sulphur. It is the only wrought for the purpose of obtaining lead. According to Thomson, there is in nature, another sulphuret of lead, of a colour more clear and brilliant, which burns with a blue flame, and which contains 25 parts of sulphur to 100 of metal; this would be the *deuto-sulphuuret*.

SULPHURET of MANGANESE. (*Sulfure de Manganèse.*) Black, pulverulent, much more fusible than manganese. Red heat does not decompose it when kept from the air; oxygen is absorbed at that temperature, and the sulphuret, disengaging sulphuric acid, becomes a sulphate. It is procured by heating intensely a mixture of charcoal and the sulphate of manganese. It is found in nature only in small masses not crystallized, or in blackish pellicles in connection with the carbonate of manganèse and tellurium. That which is obtained artificially is formed of 100 of manganese, and 56·32 of sulphur.

SULPHURET of MERCURY. (*Sulfure de Mercure.*) When a current of sulphuretted hydrogen is passed over a mercurial solution, a sulphuret is formed, which is precipitated either by a proto or a deuto salt; but the precipitate obtained in the solution of the proto-salt when sufficiently compressed yields globules of mercury; this is not the case when a deuto-salt is employed. M. Guibourt, by whom these experiments were made, supposing that the deuto-sulphuret thus obtained by sublimation may be transformed into a red sulphuret without losing its constituent principles, believes that there is but one sulphuret of mercury, and that what is regarded as a proto-sulphuret is a mixture of the red sulphuret and of pure mercury. It seems however probable that since there are two oxides of mercury, there are also two sulphurets; but it is very possible that, like the protoxide, the proto-sulphuret may be easily decomposed. The proto-sulphuret is black; it is known by the names *ethiops mineral*, *mercurial ethiops*, &c. It may be obtained, as has already been observed, by passing a current of sulphuretted hydrogen into a solution of the proto-nitrate of mercury; but it is usually procured by triturating in a porcelain mortar a mixture of sulphur and mercury, until the mixture appears of a blackish green colour; it is then put into a cup, where the combination becoming more intimate, the sulphuret becomes more and more black. It is also prepared by adding mercury to sulphur in a state of fusion, and agitating the mixture; this mode of preparation gives the sulphuret a violet tinge. When precipitated by sulphuretted hydrogen, it is formed of 100 of metal and 8·2 of sulphur, or of 1 atom of each constituent. It is employed in medicine.

The *deuto-sulphuret* is of a red colour approaching to violet when it is in a mass; when pulverized, it is of a beautiful scarlet red; it is insipid, unalterable by the air, insoluble in hydro-chloric acid. When heated sufficiently, it inflames, and burns with a blue flame, giving place to sulphurous acid and a revivification of the mercury. If reduced to vapour, and made to pass through a heated tube of porcelain, it detonates; most of the metals and lime decompose it; upon this property is founded the extraction of mercury. The deuto-sulphuret, precipitated by sulphuretted hydrogen from a solution of the deuto-nitrate, is formed of 100 of mercury and 16·4 of sulphur, or 1 atom of mercury and 2 atoms of sulphur. The red sulphuret of mercury is known by the names of *cinnabar*, *vermilion*, &c. This is formed by triturating in a porcelain mortar 300 parts of mercury with 68 parts of sulphur, and moistening the mixture with a solution of potash; the ethiops mineral first forms; more of the solution of potash being added, it is heated and evaporated; the black colour of the mixture first changes to brown and then to red. When the mass is of the consistence of jelly, the colour becomes more and more brilliant; when arrived at its greatest brilliancy, the vessel containing it is taken from the fire; if kept too long exposed to the heat, the colour would return to a dirty brown. The deuto-sulphuret of mercury exists in considerable quantities in nature; it is from this that the metal is principally extracted; it is sometimes compact, earthy, and sometimes fibrous. Its specific gravity is 7; that of the artificial sulphuret is greater. Native cinnabar is usually found in secondary formations.

Sulphuret of Molybdenum. (*Sulfure de Molybdène.*) A gray metalloid, more fusible than molybdenum, absorbs the oxygen of the air by the aid of heat, transforming itself into sulphurous and molybdic acids which volatilize. It is obtained by heating 1 part of molybdic acid with 5 parts of sulphur. It is found in nature in unctuous masses a little resembling plumbago. These masses often present a leafy structure; these leaves are a little flexible. It is also found in scales disseminated in certain rocks; it is seldom found crystallized; when it is so, the crystals are in hexahedral prisms. Its specific gravity is 4·6. It consists of 40 of sulphur and 60 of metal, or 1 atom of metal and 2 atoms of sulphur.

Sulphuret of Nickel. (*Sulfure de Nickel.*) Of a yellowish white, decomposable by heat, in contact with the air producing sulphurous acid and a sulphate which is decomposed by a higher degree of heat. It is not attracted by the magnet. It is obtained by heating a mixture of sulphur and nickel.

Sulphuret of Palladium. (*Sulfure de Palladium.*) Palladium unites readily with sulphur. If when it is highly heated sulphur is added, the mixture immediately fuses, and the sulphuret remains liquid even at a dark red heat. It is paler than the pure metal, and very brittle. By heat, an even by leaving it for a long time exposed to the air he sulphur dissipates, and the metal remains pure. A rding to Vauquelin, it consists of 100 of the metal and [illegible] of sulphur.

hydrogen into a solution of the proto-nitrate of mercury; but it is usually procured by triturating in a porcelain mortar a mixture of sulphur and mercury, until the mixture appears of a blackish green colour; it is then put into a cup, where the combination becoming more intimate, the sulphuret becomes more and more black. It is also prepared by adding mercury to sulphur in a state of fusion, and agitating the mixture; this mode of preparation gives the sulphuret a violet tinge. When precipitated by sulphuretted hydrogen, it is formed of 100 of metal and 8·2 of sulphur, or of 1 atom of each constituent. It is employed in medicine.

The *deuto-sulphuret* is of a red colour approaching to violet when it is in a mass; when pulverized, it is of a beautiful scarlet red; it is insipid, unalterable by the air, insoluble in hydro-chloric acid. When heated sufficiently, it inflames, and burns with a blue flame, giving place to sulphurous acid and a revivification of the mercury. If reduced to vapour, and made to pass through a heated tube of porcelain, it detonates; most of the metals and lime decompose it; upon this property is founded the extraction of mercury. The deuto-sulphuret, precipitated by sulphuretted hydrogen from a solution of the deuto-nitrate, is formed of 100 of mercury and 16·4 of sulphur, or 1 atom of mercury and 2 atoms of sulphur. The red sulphuret of mercury is known by the names of *cinnabar*, *vermilion*, &c. This is formed by triturating in a porcelain mortar 300 parts of mercury with 68 parts of sulphur, and moistening the mixture with a solution of potash; the ethiops mineral first forms; more of the solution of potash being added, it is heated and evaporated; the black colour of the mixture first changes to brown and then to red. When the mass is of the consistence of jelly, the colour becomes more and more brilliant; when arrived at its greatest brilliancy, the vessel containing it is taken from the fire; if kept too long substance when first formed, changing afterwards to a gray colour with a metallic lustre.

Sulphuret of Potassium. (*Sulfure de Potassium.*) The proto-sulphuret is obtained by intensely heating the sulphate of potash in a crucible lined with charcoal, (*creuset brasqué*); all the oxygen contained in this salt is disengaged in combination with carbon, and an alkaline sulphuret remains; this is flesh-coloured, translucid, and dissolves in water with an elimination of caloric. This sulphuret when pure is burned with difficulty; but inflames almost spontaneously when it contains a sufficient quantity of powdered charcoal; thus if a mixture of lampblack and the sulphate of potash be strongly heated, a compound is obtained which becomes ignited as soon as moistened. There are, as was remarked under the head of the alkaline sulphurets, many sulphurets of potash. Potash may easily be made to combine directly with sulphur; but in this case it is rare to obtain sulphurets whose proportions are uniform, and which do not contain an excess of one or the other of the constituent principles. The sulphuret of potassium is employed in medicine, but never in an unmixed state. That preparation which is known by the name of *liver of sulphur*, (*sulphuret of potash,*) is a mixture of the sulphuret of potassium, and the sulphate of potash.

Sulphuret of Rhodium. (*Sulfure de Rhodium.*) This may be procured by heating in a close crucible a mixture of sulphur and ammoniacal hydro-chlorate of rhodium; the sulphuret thus obtained is more fusible than the metal, and is easily decomposed by heating in the air. This sulphuret, according to Vauquelin, is formed of 100 of metal and 26 of sulphur. Berzelius considers it a deuto-sulphuret; he admits three sulphurets of this metal; the first containing 13.44, the second 26·88, and the third 40·32 of sulphur, numbers which are exactly multiples of 13·44 by 2 and 3.

Sulphuret of Selenium. (*Sulfure de Sélénium.*) It is probable, since sulphur and selenium unite in all proportions, that there are several sulphurets of this metal. The sulphuret of selenium is obtained by passing a current of sulphuretted hydrogen over a solution of selenic acid. The sulphuret remains in suspension in the liquor, but by adding some drops of muriatic acid, and heating it lightly, it separates in the form of a yellow elastic mass, fusible at a degree of heat a little above that of boiling water. This sulphuret volatilizes at a more elevated temperature, and on distillation gives a reddish yellow liquor resembling melted orpiment. When heated in the air it absorbs oxygen, transforming itself into sulphurous acid, and an oxide of selenium. It dissolves easily in the alkalies and the alkaline sulphurets The liquor deposites it when an acid is added. It consists of 100 of selenium, and 60·75 of sulphur.

Sulphuret of Silver. (*Sulfure d'Argent.*) Solid, black, or of a deep violet colour, more fusible than silver, may be cut with a knife, is susceptible of crystallization in little needles. It is obtained by heating in a crucible very thin leaves of silver with sulphur. The combination commences soon after fusion takes place. This sulphuret is found in nature. It is compact, shining, of a lead gray, ductile, crystallizes in cubes, octoedrons, and cubic octoedrons. It is observed also in capillary filaments. Its specific gravity is 7. It consists of 13 of sulphur and 87 of silver, or 1 atom of silver and 2 atoms of sulphur. It forms a combination with the sulphuret of arsenic, and also with the sulphuret of antimony; the latter is known by the name of *red silver;* its crystals differently modified are derived from an obtuse rhomboid; it consists of 32 of sulphuret of antimony, and 68 of sulphuret of silver; or 2 atoms of the former, and 3 of the latter.

The black spots which may be seen upon silver when brought in contact with substances which contain sulphur, are produced by the formation of sulphurets.

SULPHURET of SODIUM. (*Sulfure de Sodium.*) Sulphur is easily combined with sodium by the aid of heat; caloric and light at the same time are eliminated; the result is a sulphuret of a deep gray colour, which *inflames* when heated in contact with the air, and becomes a sulphate of soda. This sulphuret may also be obtained by heating the sulphate of soda in a crucible with charcoal; this is probably more pure than that prepared by the direct process. Sodium like potassium can form many sulphurets.

SULPHURET of STRONTIUM. (*Sulfure de Strontium.*) Is obtained by intensely heating the sulphate of strontium in a crucible with charcoal (*creuset brasqué*). It is white, granular, friable, and resembles the sulphuret of barium.

SULPHURET of TELLURIUM. (*Sulfure de Tellure.*) Is little known; it may be obtained by melting tellurium with sulphur. It is of a lead gray, of a crystalline and radiated texture; it burns with a green flame when thrown upon ignited coals. It is more fusible than tellurium.

SULPHURET of TIN. (*Sulfure d'Etain.*) Sulphur combines with tin in two proportions. The *proto-sulphuret* is of a lead gray colour, a metalloidal appearance, and susceptible of crystallizing in brilliant scales. It is less fusible than tin, absorbs oxygen by the aid of heat, producing sulphurous acid and a sulphate, which a more elevated temperature decomposes. Concentrated hydrochloric acid changes it to the oxide of tin and sulphuretted hydrogen. It is obtained by heating a mixture of 2 parts of sulphur and 3 parts of tin. It consists of 100 of tin, and 27·234 of sulphur. It exists in nature in small quantities, and always combined with copper pyrites. The *deuto-sulphuret* is in the form of light gold-coloured scales, which easily adhere to other bodies. If exposed to the action of caloric, it leaves a portion of the sulphur, and becomes a proto-sulphuret. Nitric and muriatic acids have no action upon it, but it is dissolved by a mixture of these two acids. A strong solution of potash also dissolves it by the aid of heat, giving a green solution, from which acids precipitate a yellow powder which appears to be the sulphuret of tin.

The deuto-sulphuret is used in bronzing and for rubbing the cushions of electrical machines. It has been called *massive gold*, *mosaic gold*, &c. It is generally obtained by heating for a long time in a crucible, a mixture of tin, sulphur, mercury, and muriate of ammonia. An alloy is made with 2 parts of tin, 1 part of muriate of ammonia, and 1½ parts of sulphur; this is exposed to a mild heat until the combination is completed, which is usually in about three quarters of an hour. The deuto-sulphuret of tin consists of 100 of metal and 52·3 of sulphur.

SULPHURET of TITANIUM. (*Sulfure de Titane.*) Is obtained by heating intensely a mixture of sulphur and the oxide of titanium. Its properties are scarcely known.

SULPHURET of TUNGSTEN. (*Sulfure de Tungstène.*) Colour grayish black, pulverulent; it takes a fine metallic brilliancy on being rubbed with a polishing stone. It is obtained by heating intensely with charcoal a mixture of tungstic acid and sulphuret of mercury. According to Berzelius, the sulphuret consists of 100 of metal and 33·26 of sulphur.

SULPHURET of URANIUM. (*Sulfure d'Urane.*) This combination is little known. Klaproth mixed the peroxide of uranium with double its weight of sulphur; he heated the mixture in a retort till the greater part of the sulphur was driven off; the residue was a blackish brown compact mass; by increasing the heat the remainder of the sulphur separated, leaving the uranium in the metallic state in the form of a black and heavy powder. The experiments of Bucholz, although made in a different manner, exhibited nearly the same results. He boiled even to dryness a mixture of sulphur and the oxide of uranium in an alkaline solution. The residue was heated to redness, and afterwards treated with distilled water; a dark powder was precipitated; the solution presented crystals of little needles of a red colour. The compound thus obtained, by dissolving in hydro-chloric acid, afforded sulphuretted hydrogen; this proves that it was a sulphuret of uranium and not a sulphuretted oxide.

Sulphuret of Zinc. (*Sulfure de Zinc.*) It has not a metallic lustre, is less fusible than zinc; exposed to the action of heat in contact with the air, it absorbs oxygen, produces sulphurous acid and a sulphate. This sulphuret is obtained by pouring into a solution of a chloride of this metal the solution of an alkaline sulphuret. It may also be obtained by heating a mixture of sulphur and the oxide of zinc, and by calcining the sulphate of zinc with charcoal. It is with difficulty prepared by employing sulphur and metallic zinc, it being necessary that the temperature of the latter should be very elevated, and the quantity of the sulphate produced is then small. The sulphuret of zinc exists in nature in great quantities, and presents itself in non-metalloid masses whose colours are very variable. Its specific gravity is 4·16; its primitive form is the rhomboidal dodecahedron. Some varieties are fibrous, others granular; there are some which contain sulphuret of arsenic. The natural sulphuret of zinc is called *blende;* it consists of 33 of sulphur and 67 of metal, or 1 atom of zinc and 2 atoms of sulphur. It is used in preparing the sulphate of zinc, and in making brass; in the latter case, however, *calamine,* or oxidated zinc, is most generally employed.

Sun. (*Soleil.*) The ancient chemists gave this name to gold, which they called the king of metals, and which had the colour of the sun.

Super Salt. A compound of an acid and base in which the acid is in excess.

Synthesis. (*Synthèse.*) An operation the reverse of analysis; in the latter the elements of a substance are separated in order to ascertain their nature and the proportions in which they are combined; synthesis, profiting by the knowledge derived from analysis, consists in reuniting in their proper proportions the elements which form bodies, and placing them in such circumstances as will favour their combination and produce the desired compound. Most bodies are susceptible of analysis, but there are many which cannot be reproduced by synthesis. (The causes which oppose this reproduction are treated of under the article *Affinity.*) We are able by synthesis to imitate most of the compounds in the inorganized kingdoms; but nature, or rather the Author of nature, can alone perfect the compounds of the organic kingdom.

Systems Atomistic. (*Systèmes Atomistiques.*) See *Atom.*

T.

Tannin. This is a peculiar principle which is extensively diffused in the vegetable kingdom; it is obtained pure with difficulty, on account of its tendency to form combinations with the other principles contained in the substances in which it exists. Artificial tannin however can be produced by treating oil and indigo with nitric acid, or the resins and many other substances by sulphuric acid. Tannin is solid, brown, inodorous, brittle, of a very astringent taste, and crystallizable.

When exposed to the action of caloric, it swells, produces an acid liquor, and gives for a residue an abundant charcoal: artificial tannin gives also the deutoxide of nitrogen. It is soluble in water and insoluble in acohol;

it combines with most of the acids and oxides; the compounds which result are little soluble, and for this reason tannin precipitates most of the saline solutions except those of the alkalies. Natural tannin is decomposed by nitric acid, the artificial is not; but of all the properties of tannin, the most remarkable and most useful is that of forming imputrescent, tough, and insoluble compounds with many animal substances, particularly with gelatine, which constitutes the greater part of the skin of animals. On account of this property it is emyloyed in the tanning of leather, which circumstance has given rise to its name. The tannin which is employed in the manufacture of leather is that which is contained in the bark of different trees; as the oak, sumach, &c. Tannin may be extracted from nutgalls, in which it is combined with gallic acid; obtained according to the best methods, there will still remain a portion of the substance used in its preparation. M. Proust recommends preparing it by adding chloride of tin (muriate of tin) to an infusion of nutgalls, collecting the precipitate, washing it, diluting in water, and passing over it a current of sulphuretted hydrogen, filtering and then evaporating the liquor. This tannin will retain a small quantity of muriatic and gallic acids.

Bouillon-Lagrange says that tannin can absorb oxygen and then becomes gallic acid. According to Berzelius, tannin consists of Hydrogen, . . 4·186
Carbon, . . . 51·160
Oxygen, . . . 44·654

Tantalates. See *Columbates.*

Tantalum. A metal analogous to columbium; discovered by Ekeberg, since proved to be the same as Columbium. (See this word.)

Tartar. (*Tartre.*) In Latin *tartarum*, from the Greek *tartaros.* Is deposited on the sides of casks during the fermentation of wines, forming a lining more or less thick, which is scraped off. This is *crude tartar*, and consists of a peculiar acid called tartaric acid, saturated with the potash employed in purifying the wine; it is a super-tartrate of potash.

Tartar Cream of. The popular name of the purified super-tartrate of potash.

Tartar Emetic. The tartrate of potash and antimony.

Tartar Salt of. The sub-carbonate of potash.

Tartar Soluble. Neutral tartrate of potash.

Tartar Vitriolated. Sulphate of potash.

Tartrates. Tartaric acid can combine in many proportions with salifiable bases; the compounds which result are remarkable in this respect; that when soluble in water they become less so by the addition of a certain quantity of acid, and when they are insoluble an excess of acid favours their solubility, as in the case of other salts. Most of the tartrates are insoluble, or almost so, except those of magnesia, the deutoxide of copper, and the alkaline tartrates; most of the strong acids disturb the solutions of the soluble neutral tartrates, by uniting with a portion of their bases and changing them to acid tartrates, while they facilitate the solutions of the insoluble tartrates by making them also pass to the acid state. For the same reason tartaric acid forms no precipitate in lime water, or the water of barytes, &c., or rather it will redissolve that which it has formed; but the same thing does not take place in a solution of potash or in a concentrated solution of soda or ammonia. It precipitates nothing at first, but when the quantity of alkali contained in the liquid is saturated, it forms a less soluble acid tartrate which is deposited in a crystalline state. If it is attempted to obtain a precipitate, by pouring an alkaline tartrate into the solution of a salt whose oxide forms an insoluble tartrate, the effect will not be produced, owing to the great tendency of the tartrates to form double salts, which salts are almost always insoluble.

According to Berzelius, the neutral tartrates are composed in such a manner, that the quantity of oxygen of the base is to the quantity of acid in the proportion of 1 to 8·35; Gay-Lussac and Thenard state this proportion as 1 to 12·14.

TARTRATE of ANTIMONY and POTASH. *Emetic Tartar.* It is a colourless salt, with a disagreeable metallic taste, susceptible of crystallizing in tetrahedrons or elongated octoedrons. It effloresces in the air. Exposed to the action of caloric, it decomposes, giving rise to different volatile products, and a residue formed of potash and antimony reduced by the charcoal of the acid. When pure it is soluble in 15 parts of water at the ordinary temperature and in double its weight of boiling water. Sulphuric acid forms in the solutions of emetic tartar a white precipitate, soluble in a great excess of acid, and the hydrosulphurets produce with it a precipitate whose colour varies from orange to red brown according to the quantity of re-agents employed. This precipitate, dried and heated in a crucible with the tartrate of potash, produces antimony in a metallic state.

Caustic potash also precipitates the solution of emetic tartar; this solution is very soluble in an excess of alkali. Lime water precipitates it abundantly; the precipitate is formed of the tartrate of lime and antimony; the water of barytes acts in the same manner. The alkaline sulphates do not disturb the solution of emetic tartar, but if they have an excess of acid they produce a milk white precipitate. It is precipitated by most decoctions of vegetable substances, and the precipitate is always formed of the oxide of antimony and vegetable matter. An infusion of nutgalls added to a solution of this tartar, produces an abundant yellowish white precipitate. A solution of albumen or gelatine does not disturb it.

The emetic tartar is obtained by boiling a mixture composed of water and equal parts of tartrate of potash and glass of antimony; the excess of the tartaric acid dissolves the oxide, and a triple salt is obtained by crystallization.

According to Thenard, 100 parts of emetic contain

34 of the tartrate of potash,
54 of the tartrate of antimony,
8 of water,
4 loss.

This salt is an important article in medicine; its action upon the animal economy is very energetic.

TARTRATE of POTASH. (*Tartrate de Potasse.*) A colourless salt, of a bitter taste, susceptible of crystallizing in four-sided prisms terminated by two faces. It dissolves in its weight of cold water, and in a less quantity of boiling water; it easily passes through the aqueous fusion. Its concentrated solutions can dissolve a considerable proportion of albumen in jelly. It is precipitated by all the acids sufficiently strong to take a portion of the base. This salt is used in medicine; it was formerly called *vegetable salt*. It is prepared by saturating with potash the excess of acid of the cream of tartar, (acid or supertartrate of potash) filtering and evaporating the liquor. The crystals form in a few days.

TARTRATE of POTASH (ACID.) *Super-Tartrate of Potash. Cream of Tartar.* The grape containing a certain quantity of acid tartrate of potash and tartrate of lime, these necessarily exist in the expressed juice or wine, and fermentation takes place; the quantity of alcohol which is produced precipitates these tartrates, and with them some salts, a vegetable matter, and a colouring matter; the latter is more abundant in red than in white wine. This substance is deposited in layers; when collected it is known in commerce by the name of crude tartar; this when purified is called cream of tartar. It is a hard white salt, of an acid taste, susceptible of crystallizing in quadrangular prisms with oblique bases. They contain $\frac{5}{100}$ of the water of crystallization. Cream of tartar exposed to the action of caloric decomposes, producing a certain quantity of hydro-tartaric acid. It dissolves in 15 parts of boiling water, and in 60 parts of water at the ordinary temperature. It is insoluble in alcohol.

All the bases which can form soluble compounds with tartaric acid can saturate the excess of acid of cream of tartar, producing double salts more soluble than the cream of tartar. Of the different combinations which this substance forms with the other salts and with some acids, the most remarkable is that which it forms with boracic acid. M. Soubeiran considers the soluble cream of tartar as a double tartrate, in which the boracic acid performs the part of a base, and saturates the excess of the acid of the super-tartrate of potash.

TARTRATE of POTASH and IRON. A greenish *salt*, of a sharp and styptic taste, susceptible of crystallizing in acicular prisms, soluble in water. Its solution is precipitated black by sulphuretted hydrogen, and is not precipitated by the alkalies. It is obtained by boiling in a sufficient quantity of water a mixture of cream of tartar and iron filings; the liquor is filtered and evaporated. This was formerly called *soluble martial tartar*. Different preparations of the tartrate of potash and iron have long been in use in medicine under various names. The *tartarized tincture of mars* is only an aqueous solution of potash and iron preserved by means of alcohol; by evaporating this liquor is obtained the *extract of mars*. The *chalybeated tartar* is prepared by mixing 40 parts of acid tartrate of potash with 160 parts of the tartrate of potash and liquid iron, and evaporating the mixture to dryness. The saline residue is preserved in closely stopped bottles.

TARTRATE of POTASH and SODA. A colourless salt, of a bitter taste, unalterable by the air, very soluble in water, and susceptible of crystallizing in large and regular 6 or 8 sided prisms. This salt, which is known by the name of *Rochelle Salts*, is employed in medicine; it is obtained by saturating with soda the excess of acid of the tartrate of potash.

Tartrate of Soda. This resembles in many of its properties the martial tartrate of potash; it can always be distinguished by its acicular prisms. It is prepared by a direct process.

Tartrites. See *Tartrates*.

Tears. They contain a small portion of albumen combined with soda, muriate of soda, and water. Also portions of their salts.

Tellurates. This term denotes the compounds formed by the union of the oxide of tellurium with the different alkalies and metals. If we add a solution of tellurate of potash to solutions of barytes, strontian, lead, copper, and lime, insoluble tellurates of their oxides are formed.

Tellurate of Potash. A crystalline white powder, scarcely soluble in water. It may be formed by heating the oxide of tellurium with nitrate of potash, and dissolving the residuum in boiling water. When the water cools, this substance is deposited.

Telluretted Hydrogen. (*Hydrogéne Telluré.*) A colourless gas, of an odour resembling sulphuretted hydrogen; it reddens litmus. In contact with an ignited body, it burns with a disengagement of light and caloric. This gas dissolves in water; its solution is reddened and decomposed by contact with the air, giving place to water and a brown powder, which seems to be a hydruret of tellurium. This gas may perhaps be considered as a metallic hydracid, for it possesses the property of uniting with salifiable bases. Telluretted hydrogen is obtained by treating with water an alloy of potassium and tellurium; by the decomposition of water a combination of telluretted hydrogen and potash is formed; hydro-chloric acid is then added; this disengages the telluretted hydrogen from its combination by uniting with the base; the gas is then collected over the hydrargiro-pneumatic cistern. It was discovered by Davy in 1809.

Tellurium. A brilliant metal, of a bluish white, a lamellar structure, so brittle as to be easily reduced to powder. Its specific gravity is 6·115; it fuses at a moderate temperature; if heated more, it volatilizes. Like potassium and arsenic it forms with hydrogen a gaseous compound. It burns with intenseness in oxygen gas: nitric acid dissolves it with a disengagement of caloric, and the solution forms with sulphuretted hydrogen an orange brown precipitate. Tellurium has been found in nature in a state of alloy with gold, silver, lead, copper, iron, and often with many of these metals united. It was first discovered by M. Muller in the gold mines of Transylvania. It is obtained by treating the ore usually composed of gold, iron, and tellurium, with a quantity of nitric acid sufficient to dissolve the last two metals. The solution is treated by caustic potash, which precipitates the oxide of iron, and to the new liquor is added hydrochloric açid, in order to neutralize the potash. The tellurium deposites in the form of the sub-chloride; it is washed with weak alcohol, (as it would dissolve in water,) then dried, mixed with a certain quantity of charcoal, and the mixture is heated in a retort. When tellurium is found combined with the metals, the process of extracting it must of course vary with the nature of the alloy.

Temperature. A definite degree of heat is measured by the thermometer; thus we say a high temperature, a low temperature, to denote a manifest intensity of heat or cold; the temperature of boiling water, or 212°, (equal to 100° of the centigrade thermometer,) and a range of temperature to designate the intermediate point of heat between two distant terms of theometric indication.

Tendons. Like the true skin they are composed almost wholly of gelatine—are soluble in boiling water.

Tests. See *Re-agents*.

Theory Atomistic. See *Atom*.

Thermometer. (From the Greek, *therme*, heat, and *metron*, a measure.) An instrument for measuring the degrees of heat. A thermometer is a hollow tube, hermetically* sealed, and blown at one end in the shape of a hollow globe. The bulb and part of the tube are filled with mercury, which is the only fluid that expands equally. When we immerse the bulb of the thermometer in a hot body, the mercury expands, and of course *rises* in the tube; but when we plunge it into a cold body the mercury contracts, and of course *falls* in the tube.

The rising of the mercury indicates, therefore, an increase of heat; its falling a diminution of it; and the quantity which it rises or falls denotes the proportion of increase or diminution. To facilitate observation, the tube is divided into a number of equal parts called degrees. Further, if we plunge a thermometer ever so often into melting snow or ice, it will always stand at the same point. Hence we learn that *snow* or *ice* always begins to melt at the same temperature. If we plunge a thermometer repeatedly into water kept boiling, we find that the mercury rises up to a certain point. This is therefore the point at which water always boils, provided the pressure of the atmosphere be the same. There are four different thermometers used at present in Europe, differing from each other in the number of degrees into which the space between the freezing and boiling points is divided. These are Fahrenheit's, Reaumur's, Celsius', and Delisle's.

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* To seal hermetically is to close the end of a glass vessel while it is in a melted state, the term hermetic being derived from *Hermes* or Mercury, who was considered the father of chemistry.

The thermometer uniformly used in Britain and America is Fahrenheit's; in this the freezing point is fixed at 32°, the boiling point at 212° above 0, or the part at which both the ascending and descending series commence. In the thermometer which was first constructed by Reaumur, the scale is divided into a small number of degrees upon the same length, and contains not more than 80° between the freezing and boiling point. The freezing point is fixed in his thermometer precisely at 0, the term between the ascending and descending series of numbers. Again 100 is the number of the degrees between the freezing and boiling point in the scale of Celsius, which has been introduced into France since the revolution, under the name of centigrade thermometer, (thermometer of a hundred degrees;) and the freezing point is in this, as in the thermometer of Reaumur, fixed at 0. One degree on the scale of Fahrenheit appears from this account to be equal to $\frac{4}{9}$ of a degree on that of Reaumur, and to $\frac{5}{9}$ of a degree on that of Celsius.

The space in Delisle's thermometer between the freezing and boiling points is divided into 150°; but the graduation begins at the boiling point, and increases towards the freezing point. The boiling point is marked 0, the freezing point 150°. Hence 180 F. = 150 D., or 6 F. = 5 D. To reduce the degrees of Delisle's thermometer under the boiling point to those of Fahrenheit's, we have F. = 212 + 65 D. Upon the knowledge of this proportion, it is easy for the student to reduce the degrees of any of these thermometers into the degrees of any other of them.

Thorina. See *Oxide of Thorinium.* The substance formerly known by this name, has since been ascertained to be only a phosphate of yttria. Very recently however Berzelius has discovered a new substance resembling this in its properties; hence its name. Thorina is white and irreducible by charcoal and potassium after being strongly calcined; it is attacked by none of the acids except concentrated sulphuric, even after being treated with caustic alkalies. The *sulphate* of thorina is very soluble in cold water, and almost insoluble in boiling water; so that it may be freed from other salts by washing the mixture with boiling water. Thorina dissolves easily in carbonate of ammonia; an elevation of temperature occasions a precipitation of a part of the earth, but on cooling the precipitate disappears. All the salts of thorina have a pure astringent taste very similar to that of tannin. The chloride of thorium treated with potassium is decomposed with a triple deflagration. There results a gray metallic powder which does not decompose water, but which raised above a red heat burns with a splendour almost equal to that of phosphorus in oxygen gas. Nevertheless thorium is feebly attacked by nitric and sulphuric acids. The hydro-chloric on the contrary dissolves with a brisk effervescence. Thorina, or the oxide of thorium, contains 11·8 of oxygen. Its specific gravity is 9·4. Thorina exists in a new mineral which has been found only in very small quantities at Brevig in Norway.*

THORINIUM. A name given to the supposed base of thorina, now proved to be a phosphate of yttria; it has not yet been insulated.

THORIUM. The base of the newly discovered substance, thorina.

TIN. (*Etain.* In Latin *stannum;* called *Jupiter* by the alchemists.) A white, brilliant, malleable metal; its specific gravity is 7·291. It fuses at about 412°; if the temperature is elevated, it inflames and oxidates. It combines easily with phosphorus, sulphur, chlorine, and iodine; it also forms many alloys which are employed in the arts. Nitric acid oxidizes but does not dissolve it. The solutions of tin form with the alkalies a white precipitate soluble in an excess of potash or soda; it is not precipitated by sulphuretted hydrogen, but the hydrosulphates produce with it chestnut-coloured precipitates if it is a protoxides, and orange-coloured precipitates if it is a peroxide. Tin is usually found in nature in the state of an oxide; the sulphuret is very rare. Tin is obtained by roasting the oxide when it contains sulphurets or arseniates of iron. See *Oxide of Tin.*

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* This article is extracted from the first volume of a valuable work on Chemistry recently published by Prof. Silliman.

Tincal. A name given to native borate of soda. See *Borate of Soda.*

Titanium. A metal of a redder hue than copper, infusible, very brittle. It has yet been obtained only in the form of brilliant pellicles. Its specific gravity is not known. It absorbs the oxygen of the air at an elevated temperature, and passes to the state of a blue oxide which appears rather to perform the part of an acid than an oxide. Titanium is not affected by nitric acid; but its oxide combines with it, and produces a solution which is not precipitated by sulphuretted hydrogen, but forms a red brown precipitate with the ferro-cyanate of potassium.

Titanium was first observed by Gregor in Cornwall, England. It is found in nature in the state of a gray oxide; it is often combined with silex and lime. The most pure form of native titanium is in a mineral called *rutile*, (*ruthile*,) whose crystals are often united, and which almost always contain the oxides of iron and manganese. The oxide of titanium is extracted from these minerals; the pure metal is obtained from the oxide by mixing it with charcoal, making a paste of this mixture with oil, and exposing it in a retort to a temperature sufficiently elevated to reduce it.

Tombac. White alloy of copper with arsenic.

Toxicology. (From the Greek *toxon*, poison, *logos*, a discourse.) A dissertation on poisons. The most celebrated is that of Orfila.

Tragacanth (Gum.) The substance vulgarly called *gum dragon*, exudes from a prickly bush, the *Astragalus tragacantha*, which grows wild in warm climates. This gum differs from all other gums in giving a thick consistence to a much larger quantity of water; it dissolves but imperfectly.

Tree of Diana. (*Arbre de Diane.*) A name given to elegant crystals of silver with a little mercury. These are easily obtained by putting into a decanter an amalgam prepared with 1 part silver, 6 mercury, 6 parts of the solution of silver in nitric acid, and as much of the solution of mercury in the same acid; to these are added 40 parts of water, and in a short time upon the amalgam will be formed beautiful imitations of the branches of trees.

Tree of Saturn. (*Arbre de Saturn.*) A name given to metallic crystallizations analogous to the preceding. It is formed of 1 part of acetate of lead dissolved in 30 parts of water; this solution is put into a decanter, from the mouth of which is suspended by the cork a piece of zinc of half the weight of the acetate of lead. The decomposition now commences, and the lead crystallizes around the piece of zinc. This establishes an element of the voltaic pile; the precipitating metal is always positive, the precipitated metal always negative. From thence arises the decomposition of the water, of the salt which was dissolved in it, and the reduction of the metal which it contained. The crystals of lead shoot out in every direction from the zinc, in an arborescent form. It is necessary that the operation should proceed without any agitation of the liquor.

Trona. The sesquicarbonate of soda. It is found in a native state on the banks of the soda lakes in Africa, and consists of one atom of soda, an atom and a half of acid, and two atoms of water.

Tubes. Cylindrical vessels of glass or metals, either straight or bent, which serve to connect the different parts of an apparatus.

Tube of Safety. A tube open at both ends inserted into a receiver, the upper end communicating with the external air, and the lower being immersed in water. Its intention is to prevent injury from too sudden condensation or rarefaction taking place during an operation. For if a vacuum be produced within the vessels, the external air will enter through the tube; and if air be generated, the water will yield to the pressure, being forced up the tube. Thus, too, the height of the water in the tube indicates the degree of pressure from the confined gas or gases. It is now more frequently used in a curved form, and is commonly called *Welter's tube.*

Tungstates. Although tungstic acid does not possess acid properties in a very marked degree, yet the tungstates are with difficulty decomposed, because their acid is neither liberated nor volatilized by caloric: When a tungstate is submitted to the action of this agent, it decomposes, but at a temperature sufficiently elevated to reduce the metal, if the metal is reducible by heat alone; if this is not the case, the tungstate undergoes no alteration. All are insoluble in water, except those of potash, soda, and ammonia. When a powerful acid, as sulphuric or nitric acid, is put into a solution of tungstate of potash or of soda, the decomposition is not total at the ordinary temperature; a sulphate, a nitrate, &c., is obtained, which remains dissolved in the liquor, and a white precipitate which is a combination of much tungstic acid, of a certain quantity of the base to which it was united, and of a certain quantity of the acid employed to separate it. But if the acid is in excess and the temperature elevated, the decomposition is total after boiling a little, and the precipitate becomes yellow, which indicates that it is formed of tungstic acid. (*Thenard.*)

In nature there have been found but three tungstates. The tungstate of iron and manganese (*wolfram*) is black and very heavy; its specific gravity is 7·3. Its primitive form is a rectangular prism, but often altered by truncation.

The *tungstate of lime* (*sceehlite*) is white, crystallizes in octoedrons, often grouped. Its specific gravity is 5·5. The *tungstate of lead* is very rare; it has been found in Bohemia in a tin mine. It is yellow or green, and crystallizes also in octoedrons; its specific gravity is 8. The soluble tungstates which are colourless are obtained directly; the others are obtained by double decomposition. In these salts the quantity of oxygen of the oxide is to the quantity of oxygen of the acid as 1 to 3, and to the quantity of acid in the proportion of 1 to 15·075.

Tungstate of Ammonia. A white salt, crystallizes in very fine 4-sided prisms or in micaceous scales. Its taste is styptic; it does not alter by the air, but is easily decomposed by heat, and by many acids. It is obtained directly.

Tungstate of Potash. A white deliquescent salt, of a caustic and astringent taste, crystallizes with difficulty. It is obtained by heating an excess of tungstic acid with a solution of potash. In preparing it, the wolfram, or tungstate of iron and manganese, is employed; the latter is heated with hydro-chloric acid, which dissolves the oxides of iron and manganese without attacking the tungstic acid, which is afterwards united to the potash.

Tungstate of Soda. A white salt of a sharp and burning taste, very soluble in water, and susceptible of crystallization in very short hexahedral prisms; it is obtained like the preceding.

Tungsten. (*Tungstène.*) (Swed. *Tungsten*, ponderous stone.) A very hard brittle metal, of a grayish white, brilliant and almost infusible. Its specific gravity is 17·6. At red heat it absorbs oxygen from the air, and becomes brown. The acids do not sensibly affect it. Its oxide forms no salts either with the acids or the alkalies; but its acid, which is blue, can unite with the last and neutralize them. It may be seen by these properties, that tungsten seems scarcely to belong to the metals, but rather to deserve a rank with osmium, and some other substances which constitute a link between the non-metallic combustible bodies and the metals. It has been found in nature, only in the state of an acid combined with the oxides of calcium, iron, manganese, and lead. It is extracted from the tungstic acid, by mixing this with charcoal and making a paste with oil; this paste is heated in a crucible of charcoal, and the acid is reduced. The discovery of tungsten is due to Elhuyart, though Scheele and Bergmann hinted at its existence.

Turpeth Mineral. (*Turpéth Minéral.*) Ancient name for the *sub-deuto-sulphate of mercury*, on account of its yellow colour, which was compared to that of the turbith.

Tumeric. *Curcuma.*

Tutty. An impure oxide of zinc.

Turnsol. See *Litmus.*

U.

Ulmin. (*Ulmine.*) A solid, inodorous, insipid substance, of a shining black; it is insoluble in cold, and very little so in boiling water; it however gives to the latter a yellow tinge. Alcohol and sulphuric acid slightly dissolve it; it reddens litmus; with the alkalies it forms combinations which are very soluble in water, are decomposed by acids and by the earthy salts. The nitrates of lead and mercury discolour a solution of ulmin and precipitate it brown. This substance was discovered by Vauquelin in the brown exudation of the elm (*ulmus*). Klaproth, Berzelius, and Braconnot have studied this substance. Berzelius believes that it constitutes a part of all barks; Braconnot found it in turf, mould, and in clayey lignite.

ULTRAMARINE. See *Blue.*

UMBER. An ore of iron.

URANIUM. A solid metal, very brilliant, brittle, of a deep gray, specific gravity 9.000. This metal is scarcely softened by the most intense heat. When heated in the air, it absorbs oxygen, and becomes a black oxide. It is very scarce in nature; is found only in the state of a phosphate and a protoxide. It is obtained like chromium, by calcining the oxide strongly in a crucible, with charcoal. It was discovered by Klaproth in a mineral called *Pech-blende*, or oxide of uranium. Combined with carbonic acid, it forms the *Chalcolite* or green mica.

URET. (*Ure.*) The compounds of simple inflammable bodies with each other, and with metals are commonly designated by this word as *sulphuret* of phosphorus, *carburet* of iron, &c. The terms bi-sulphuret, bi-sulphate, &c., applied to compounds, imply that they contain twice the quantity of sulphur, sulphuric acid, &c., existing in the respective sulphuret, sulphate, &c.

V.

VAUQUELINE. When Pelletier and Caventon made the discovery of *strychnine*, they gave it the name of Vauqueline, in honour of a celebrated chemist; but when the memoir of the discoverers was read to the French National Institute, it was decided that the name proposed was not properly bestowed upon a substance of so deleterious a nature; and that it should be called strychnine from *Strychnos*, the plant in which it seemed to be most abundant.

VENUS. An ancient name for *copper*.

Veratria. (*Veratrine.*) A white inodorous substance, very sharp to the taste, without any bitterness. It fuses at 122°, becoming a white mass like wax; at a higher degree of temperature it decomposes, and gives all the products of vegeto-animal substances. It is soluble in ether, and alcohol, wholly insoluble in cold water, boiling water scarcely dissolves $\frac{1}{1000}$ part, yet this small quantity communicates to it a very sensible sharpness of taste; in a degree, it possesses alkaline properties, changes litmus paper, reddened by an acid, blue, and saturates the acids with which it forms uncrystallizable salts. Concentrated nitric acid decomposes it without giving it a red colour. This organic alkali was discovered by Pelletier and Caventon in 1819, in the seed of the *Veratrum sabatilla* or cevadilla, the *Veratrum album* or white hellebore, and the bulbs of the *Colchicum autumnale* or meadow saffron. In obtaining this substance, the pounded seeds of the cevadilla are first treated with sulphuric ether, which dissolves an oily matter, a colouring matter, and an odorous acid; the residue is several times treated with boiling alcohol, the different solutions being cooled, filtered, and evaporated to an extractive consistence; it is redissolved in cold water; the aqueous solution, on being evaporated, deposites a reddish matter; when the liquor has acquired a degree of concentration, it is precipitated by the acetate of lead, a current of sulphuretted hydrogen precipitates the excess of lead, and a colourless liquid is obtained; this being treated with magnesia, the veratrine precipitates with the magnesia; the veratrine is dissolved by boiling the precipitate in alcohol; on filtering and cooling, the veratrine is in part deposited; the other part is obtained by evaporating the alcoholic solution. According to Pelletier and Dumas, this substance consists of

Carbon .	66·75
Azote .	5.04
Hydrogen	8.54
Oxygen .	19.60

According to the experiments of Magendie, veratria exercises upon the animal economy, the same action as the cevadilla and the hellebore, but with much greater energy.

Verdigris. (*Verdet.*) (*Vert-de-gris.*) (In Latin, *ærugo.*) An impure acetate of copper; being a mixture of the acetates and the carbonates of copper, and the hydrated oxide of copper; by *crystallized verdigris* is understood the neutral acetate of copper.

Verditer. A blue pigment obtained by adding chalk or whiting to a solution of copper in aquafortis.

Verjuice. A kind of harsh sharp vinegar made of the expressed juice of the wild or crab apple; also applied to the sour juice of unripe grapes.

Vermilion. The red sulphuret of mercury, or cinnabar. See *Sulphuret of Mercury.*

Verre. See *Glass.*

Vert de Scheele. See *Green Scheele's.*

Vif-Argent. See *Mercury.*

Vin. See *Wine.*

Vinegar (*Vinaigre.*) See *Acetic Acid.*

Vital Air. See *Oxygen.*

Vitreous. (From *vitrum,* glass.) Glassy.

Vitrification. See *Glass.*

Vitriol Blue. Sulphate of Copper.

Vitriol Green. Sulphate of Iron.

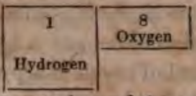
Vitriol White. Sulphate of Zinc.

Vitriolic Acid. See *Sulphuric Acid.*

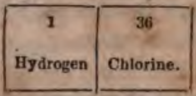
Volatile Alkali. See *Ammonia.*

Volatility. A property of bodies by which they tend to assume the vaporous or elastic state.

Volumes Theory of. When bodies unite so as to form one compound only, that compound always contains the same relative proportions of its components; and when two bodies unite in more than one proportion, the second, third, &c., proportions are multiples, or divisors of the first. This law is well exhibited in the combinations of gaseous bodies. These are seen to unite in simple ratios of volume. Water is composed of hydrogen and oxygen; 1 part by weight of the former gas unites to 8 of the latter. The specific gravity of hydrogen compared with that of oxygen is as 1 to 15; it is obvious therefore that 1 volume of hydrogen unites to half a volume of oxygen, and that the composition of water will be represented by weight and volume, thus:



Muriatic acid gas consists of 1 part by weight of hydrogen and 36·0 by weight of chlorine. The relative specific gravities of these gases are as 1 to 36. It is obvious therefore that they combine in equal volumes, and that muriatic acid gas may be thus represented:



W.

WACKE. A mineral substance intermediate between clay and basalt.

WATER. (*Eau.* In Latin, *aqua.*) It is ordinarily found in the form of a transparent, colourless, inodorous liquid, capable of dissolving a great variety of substances. It is liquid at the common temperature of our climate, but becomes solid at 32°; and assumes a gaseous form at 212°, occupying a volume 1700 times greater than in the liquid form; it returns unaltered to its liquid state at any degree of heat intermediate between these two points. The process called freezing is in fact the crystallization of water; its crystals, usually confused, are regular hexagonal prisms. Water is a bad conductor of the electric fluid; it strongly refracts light. It dissolves most of the gases, but in variable quantities; nitrogen is among those of which water dissolves the least. Water can be charged with a great quantity of oxygen, and then exhibits peculiar properties. See *Water Oxygenated.*

Water affects substances both simple and compound in a very different manner, dissolving many, decomposing some, and having no action on others. Water is seldom found pure in nature; in order to obtain it in this state, it must be distilled. This substance in a solid form constitutes immense glaciers upon the summits of mountains, and exists in vast quantities in the polar regions.

The clouds and vapours of the atmosphere are the same substance in a gaseous form. When condensed by cold, it solidifies; being then heavier than the air, it falls in the form of snow, hail, or rain.

Water was long regarded a simple principle; it is now known to be a combination of oxygen and hydrogen, in the proportion of 88·90 of oxygen, 11·10 of hydrogen; or in volume of 1 of oxygen and 2 of hydrogen; or which is the same thing, of 1 atom of oxygen and 2 of hydrogen; then one atom of water would weigh 1·125, the sum of the 1 atom of oxygen and 2 of hydrogen. *Water is the protoxide of hydrogen;* oxygenated water is the deutoxide.

Water of Barytes. (*Eau de Baryte.*) Solution of barytes, or a salt of barytes in distilled water. It is one of the most common re-agents in chemistry; its use is principally to show the presence of sulphuric acid.

Water of Crystallization. Many bodies in crystallizing, retain a quantity of water, this is termed their water of crystallization.

Water Distilled, (*Eau Distillée.*) The purity of distilled water is proved by its having no action upon coloured papers, not being precipitated by water of barytes, nitrate of silver, the deuto-chloride of mercury, or oxalic acid.

Water of Lime. (*Eau de Chaux.*) This is a solution of lime in water. Water saturated by lime contains but $\frac{1}{400}$ part. It is much used as a re-agent, to show the presence of carbonic acid, oxalic acid, &c.

Water Mineral. (*Eau Minérale.*) The waters of some springs, are impregnated with a certain quantity of saline substances, and are thus enabled to act upon the animal economy; they are very useful as medicines.

Water Oxygenated. (*Eau Oxigénée.*) This is the deutoxide of hydrogen; it was discovered and carefully investigated by Thenard. It is obtained by dissolving the deutoxide of barium in liquid muriatic acid, pouring into the solution a certain quantity of sulphuric acid, adding sulphate of silver, then barytes, and separating successively all the precipitates by filtering. When water is most highly oxygenized, it seems to consist of equal volumes, making 2 atoms of oxygen for 1 atom of hydrogen.

It is a colourless liquid, of a peculiar taste, susceptible of vaporizing without being decomposed. It destroys the colour of litmus; congeals at some degrees below the freezing point of water. Its density is 1·452. The metals generally decompose it, reducing it to the state of a protoxide. Iron, tin, and a few others are exceptions.

Water of Life. (*Eau de Vie.*) Alcohol.

Water of the Sea. (*Eau de Mer.*) Sea water, besides a great quantity of common salt, (*chloride of sodium,*) contains small portions of muriates of lime and magnesia, also sulphates of these two bases, and perhaps a little carbonic acid.

Wax. (*Cire.*) Is solid, white, insipid, and inodorous: it melts at 154°, dissolves in warm ether and alcohol, and precipitates when cold. The essential and fixed oils dissolve it in all proportions. Wax is a substance extensively diffused in nature; it is found on the surface of the leaves of vegetables, in the pollen of flowers, and many trees produce it abundantly. Since wax is so extensively diffused, it would seem as if that which is obtained from bees, is not formed by these insects, but is a product of nature. M. Huber, however, says that bees which feed upon sugar, produce wax in as great a quantity as those whose food might seem to contain this substance.

Wine. (*Vin.* In Latin *Vinum.*) The general term vinous is applied to all liquors which have been subjected to the spiritous fermentation (see *Fermentation*); as beer, cider, metheglin. The term wine (*vin*) is chiefly limited to the fermented juice of the grape. Although all sugared substances can furnish an alcoholic liquor, all do not produce that which is equally good. Such wines as are richest in alcohol and aroma, are called *generous wines* (*vins généreux*). Wines may be divided into three principal kinds: the *red wines*, (*vins rouges*,) as port, claret, &c.; the *white wines*, (*vins blanchès*,) as Madeira, &c.; and the *sparkling wines*, (*vins mousseux*,) as Champaigne, &c.

Wollaston's Theory of Crystallization. Doctor Wollaston first suggested that the form of the integral molecules of crystals might be perfect spheres, and he has shown that by joining these together, a number of crystals may be obtained, as the octoedron, the tetraedron, the acute-rhomboid, and even the cube.

Wood. (*Bois.*) The liqueous or woody tissure, which contains between its fibres or in its vessels the sap, proximate principles, colouring matter, &c. Wood separated from these substances, and reduced to vegetable fibre, takes chemically the name of woody fibre, (*ligneum*.) (See this word.)

All wood contains at least 0.950 of this fibre in 100 parts;
there are Carbon 52
Oxygen 48, and hydrogen in necessary proportions to form water.

Wood calcined in a particular manner, produces the charcoal sought for use in many chemical experiments. The calcining of wood in the large way in order to produce charcoal for domestic purposes, and for use in the arts, is carried on in what are called *coal kilns.*

Woody Fibre. (*Ligneux.*) A solid body of a dirty white, of a specific gravity greater than water. Submitted to distillation in a retort, it gives similar products to vegetable substances. It is little soluble in potash; when treated by sulphuric acid, it forms an acid which Braconnot calls vegeto-sulphuric acid, and which Thenard considers as hydro-sulphurous acid, united to a vegetable substance.

The *ligneux* is abundant in vegetables, in the flowers, fruit, leaves, roots, and stems. It constitutes $\frac{90}{100}$ of all wood in general; it is produced in its most pure state, by treating sawdust successively with water, alcohol, muriatic acid, and a weak solution of potash.

Wool Philosophic. (*Laine Philosophique.*) Name given by ancient chemists to the sublimed oxide of zinc.

X.

Xanthoge'ne. See *Acid Xanthic.*

Y.

Yest. (*Ferment.*) A viscous floscolous matter which separates from vegetables when submitted to fermentation. That which is produced from the fermentation of beer, is chiefly used in domestic economy, and is vulgarly called *emptings*, or *emptyings*. It may be dried, and in this situation preserved for an indefinite period. In contact with oxygen at a temperature somewhat elevated, it decomposes, transforming itself to carbonic acid; if at the same temperature it is left to stand for some time in close vessels, it putrifies in a few days. It dissolves neither in water nor alcohol. If submitted to distillation, all the products of animal substances are obtained. See *Fermentation*.

Yellow King's. Much used in dyeing. It is prepared from *Orpiment*.

Yellow of Naples. (*Jaune de Naples.*) *Patent yellow.* It is employed in oil painting; it is a chloride of lead, prepared by mixing 200 parts of litharge with 5 parts of common salt, and 4 times their weight of water. This paste swells, takes consistence, and becomes white; two or three days afterwards, it is lixiviated in order to separate the soda, and the residue, which is of a beautiful yellow colour, is melted. This paste is sometimes called *Mineral Yellow.*

Yttria. See *Oxide of Yttrium.*

Yttrium. This metal has never been obtained; its existence is admitted by analogy.

Yttro-Cerite. A mineral containing oxide of cerium, yttrium, &c.

Yttro-Tantalite. An ore of tantalum, from which columbic acid is procured.

Z.

Zaffre. (*Saffre.*) The residuum of cobalt after the sulphur, arsenic, and other volatile matters of this mineral, have been expelled by calcination.

Zeine. A yellow substance having the appearance of wax, obtained from indian corn, (*Zea Mays*).

Zinome. See *Gluten.*

Zinc. (From a German word *Zincum.*) A solid bluish white metal, little ductile, somewhat malleable, and of a lamellar structure. When heated without being exposed to the air, it fuses below red heat, and volatilizes entirely; if heated in the air, it absorbs oxygen rapidly, solidifies, and produces a beautiful flame of a brilliant greenish blue colour. The metal passes to the state of a white oxide, which on account of its lightness, rises into the atmosphere. Phosphorus and sulphur unite with this metal, producing a phosphuret and a sulphuret; the first is brilliant, and has a metallic appearance; the second appears tarnished, and is less fusible than zinc. Boron, carbon, hydrogen, and nitrogen, have no action upon this metal. Zinc, like iron, decomposes water by the aid of heat, absorbs oxygen, and liberates hydrogen; at a high temperature it absorbs the oxygen from phosphoric acid; it decomposes concentrated sulphuric acid disengaging sulphurous acid, and the oxidated metal combines with the portion of acid not decomposed; but when the sulphuric acid is feeble, it oxidates at the expense of the oxygen of the water, and the acid undergoes no decomposition. Concentrated ammonia acts strongly upon zinc; the water of the former is decomposed; its oxygen burns the metal, its hydrogen is disengaged, and furnishes little acicular crystals, from which ammonia may be disengaged by heat. Zinc has never yet been obtained pure in a metallic state; it is always from *calamine* that the metal is extracted. Zinc is employed in making brass, in the construction of voltaic piles, &c. Attempts have been made to employ it in the manufacture of kitchen utensils; but it is discovered to be too easily attacked by acids and fat substances; its use has therefore been relinquished.

Zirconia. See *Oxide of Zirconium.*

Zirconium. It has been known but a short time. Berzelius succeeded in separating it from oxygen, with which it constitutes zirconia. It does not appear to possess the properties of metals. According to Berzelius, it is black, like charcoal; it oxidates neither in the air, water, or in muriatic acid; but dissolves in *aqua regia* and fluoric acid, with a disengagement of hydrogen. It burns with intenseness at a temperature a little elevated. It combines with sulphur, and forms a chestnut brown sulphuret, like that of silicium; this sulphuret does not dissolve in muriatic acid and in the alkalies, which it burns with a disengagement of caloric and light, producing sulphurous acid and zirconia. Berzelius obtained zirconium in the same manner as silicium.

SKETCH

OF

ELEMENTARY CHEMISTRY.

GENERAL VIEW.

CHEMISTRY is a science no less elevated in its general views than various in its applications; its object is to examine the *elements* or *first principles* of substances and their laws of combination; its application to other sciences, to arts, medicine, manufactures, and housewifery, are numerous and important. It may be divided into *organic* and *inorganic* chemistry.

Organic chemistry is confined to the investigation of the elements of vegetable and animal substances, and the laws which govern their combinations. This department, including the whole of animal and vegetable poisons, and their antidotes, is intimately connected with the study of medicine. The same elements, differently proportioned and combined, constitute all organic and inorganic substances.

Inorganic chemistry includes the study of the elements of all matter confined to the combinations of these elements in inorganic bodies. The ancients conceived that there were but *four elements*, or first principles, viz : *Earth*, *air*, *fire*, and *water*. Chemistry has shown that all these substances, except fire, (the nature of which is still doubtful,) are compounds : air of two gases, called oxygen and nitrogen; water of oxygen and hydrogen ; and earth of a variety of substances, which in their turn may be decomposed.

Sir Humphrey Davy beautifully observes, that,

"The forms and appearances of the beings and substances of the external world, are almost infinitely various, and in a state of continual alteration.

"The whole surface of the earth undergoes modifications; acted on by moisture and air, it affords the food of plants; an immense number of vegetable productions arise from apparently the same materials; these become the substance of animals; one species of animal matter is converted into another; the most perfect and beautiful forms of organized life ultimately decay, and are resolved into inorganic aggregates, and the same elementary substances differently arranged, are contained in the inert soil, or bloom and emit fragrance in the flower, or become in animals the active organs of mind and intelligence. In artificial operations, changes of the same kind occur; substances having the characters of earth, are converted into metals ; clays and sand are united so as to produce porcelain ; earths and alkalies are converted into glass ; acrid and corrosive matters are formed from tastless substances ; colours are fixed upon stuffs, or changed, and made to disappear; and the productions of the mineral, vegetable, and animal kingdoms are converted into new forms, and made subservient to purposes of civilized life. To trace in detail these diversified and complicated phenomena, to arrange them, and deduce general laws from their analogies, is the business of chemistry."

Nature offers substances in four different states, solid, liquid, gaseous or aëriform, and imponderable, or such agents as are not known to possess weight. All matter is composed of *molecules*, particles, or atoms, which are subject to two opposing laws, the *force of attraction* which tends to keep the atoms in contact, and that of *caloric*, or heat, which separates or repels them.

Simple substances are those whose atoms are homogeneous, or of the same nature. Thus zinc is considered as a simple substance, because it contains no other atoms than those of zinc.

Compound substances are such as contain two or more simple elements; thus brass is a compound body, which on being decomposed, is found to contain atoms of zinc and copper. The particles which constitute a simple body, are called *integrant molecules*, and the force which keeps them together, is called *cohesion*. The particles which form a compound substance, are called *constituent* molecules, and the force which unites them, is termed *affinity*. Thus zinc is formed of integrant molecules, united by the force of cohesion, and brass is formed of constituent molecules, united by the force of affinity.

AFFINITY.

Affinity is that kind of attraction which unites the heterogeneous molecules, or atoms of compound bodies. A knowledge of chemical affinity is very important in investigating chemical changes; the first consequence of this law is a change of state of the bodies; thus the union of two gases, oxygen and hydrogen, produces water. A second and important consequence is a change of the property of the new substance; thus from the combination of an acid and an alkali possessing opposite properties, results a salt resembling neither of the original substances. It is at present believed by most chemists, that chemical affinity depends essentially upon the electrical state of the substances, that electricity is divided into two fluids; the one *positive*, the other *negative*, and that molecules of the same kind of electricity repulse, while those of opposite electricities attract each other.

THEORY OF ATOMS.

By atoms or particles are understood parts incapable of division or diminution; much precision is given to the science of chemistry by admitting that bodies consist of atoms which unite in certain proportions; thus in water we suppose 2 atoms of hydrogen united to 1 of oxygen; or, which is the same thing, 200 atoms of the former to 100 of the latter. The theory of the proportions between the elements of bodies is not hypothetical, but in many cases has been proved by experiment; thus the following proportions are uniformly observed:

200 atoms of hydrogen and 100 of oxygen = water.
300 do. and 100 nitrogen = ammoniacal gas.
100 ammonia and 50 carbon = salt of ammonia.
100 nitrogen and 50 oxygen = protoxide of nitrogen.
100 do. and 100 do. = deutoxide of nitrogen.
100 do. and 150 do. = nitrous acid.
100 do. and 250 do. = nitric acid.

SIMPLE ELEMENTS.

The number of simple elements admitted by chemists varies with the progress of the science; such substances as no chemical force can decompose are called simple:

many which are thus named, will no doubt, in process of time be decomposed, while other elements, now unknown, will be brought to light, and found to be important agents in chemical changes.

Instead of the four elements of the ancients, chemists at present admit more than 50 elementary bodies, if we include the imponderable agents, chlorine, and some other analogous substances; and the newly discovered bodies, bromine, pluranium, and thorium.

These may be comprehended under two grand divisions:

I. *Imponderable agents*, or such as have no known weight; as *Caloric*,
Light,
Electricity,
Magnetism.

II. *Ponderable bodies*, or such as have known weight; these may be divided into four classes.

Class 1. *Supporters of Combustion;* as oxygen, &c.

Class 2. *Combustibles* not *metallic;* as hydrogen, &c.

Class 3. *Metalloids;* as silicon the base of silex, calcium of lime, &c.

Class 4. *Metals*.

LANGUAGE OF CHEMISTRY.

Among the most important chemical agents is oxygen, the discovery of which wholly changed the aspect of the science, and gave rise to our present nomenclature, or names of substances. The term *combustible*, considered as synonymous with *oxygenable*, is applied to all simple substances which can be made to unite with oxygen; this union is accompanied with a disengagement of caloric or heat, (though in some cases imperceptible,) and often of light; the substance which has thus united with oxygen is said to be *burnt*, or *oxygenated.*

The compounds which result from the union of oxygen with simple bodies have received the name of *oxides* and *acids.* When oxygen unites with a body but in one proportion, forming either an oxide or an acid, the substance with which it combines is termed its *radical;* as in the *oxide of zinc*, here zinc is the radical, or base of the oxide. If the oxygen combines in two or three proportions, the first oxide is called *protoxide*, the second *deutoxide*, the third *tritoxide;* when a body is oxidized in the highest degree it is termed the *peroxide;* as for example, the combinations of oxygen and manganese which present us with all these varieties of oxides.

A similar rule governs with respect to the names of acids; if the oxygen forms but one acid, to its radical is added the termination *ic*, as *boracic acid.* But if oxygen combines in several proportions, the lowest proportion is expressed by *ous*, and the highest by *ic*, as *sulphurous* and *sulphuric* acids; to these terminations are also added *hyper*, which signifies more, and *hypo*, less; thus hyposulphurous acid denotes a body possessing a less quantity of oxygen than sulphurous acid, &c.

Oxygen is not the only agent which unites to combustible bodies to produce acids; hydrogen, chlorine, with some other substances, possess this property; thus we have hydro-chloric, and hydriodic acids, resulting from the union of hydrogen with chlorine and iodine.

When two binary* burnt substances combine, a new compound results, which, when the constituents are an acid and a metallic oxide, is called a *salt*. The salts are very numerous; they are named by varying the termination of their acid, when the acid terminates in *ous* and *ic*, the salt ends in *ite* and *ate;* thus by the term *sulphate of tin*, we understand the combination of tin with *sulphuric acid*; *sulphite of tin* expresses the combination of the metal with sulphurous acid.†

IMPONDERABLE AGENTS.

CALORIC and LIGHT. It would not be possible to explain the sensation of heat to one who had never experienced it, any more than we would by words, give to the blind an idea of colours, or to the deaf of sounds. A person says *I am warm*, or extending his hand to a fire, says *the fire is hot;* in the first case he properly expresses the *the sensation of heat;* in the second, the *cause of this sensation*. The fire itself is not supposed to be hot, but only to possess the property of producing in the animal system the sensation of heat. The *cause of heat* is distinguished from *heat* by the term *caloric*.

Light, as is well known, proceeds from the sun and the fixed stars, as direct sources; from the moon and other

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[*] The term binary, is derived from *bis*, two; a *binary* compound is one in which but two elements are united; a *ternary* compound consists of three elements; a *quaternary*, four, &c.

[†] For further illustration of the chemical names of salts, see article *Nomenclature Chemical*.

planets, by reflection, and from various terrestrial substances, while experiencing combustion from phosphorescent matter, &c. The nature of light and caloric is at present unknown; from the intimate connection between them, they have by some been considered only as modifications of the same substance.

Among the most important properties of caloric, are

1. Its tendency to an equilibrium.

2. Its power of dilating bodies.

3. Its susceptibility of being reflected from one body to another.

4. Its power of increasing chemical action.

ELECTRICITY and MAGNETISM. From whence arises the peculiar sensation which is experienced when a piece of zinc placed upon the tongue, is brought in contact with a piece of copper placed under this organ? What power was that which, under the eyes of Galvani, animated the limbs of a dead frog, when two metals, placed at the extremity of a naked nerve, were made to communicate by means of a metallic wire? What dazzling brilliancy flashes in the skies, or darts downwards upon earth, fraught with terror and destruction? It is the *electric fluid*. But what is the nature of this fluid which divides the material world into two great masses, the *positively* and *negatively electrified?* Is it simple or compound? Why is its presence so uniformly accompanied with light and heat? Are light and caloric any thing more than modifications of this fluid, and is not electricity indeed the union of these two substances?

Electricity, whatever it may be in itself, exercises an important influence in chemical changes. The instrument called the *voltaic pile*, causes the decomposition of a compound body, which is submitted to its action; the elements possessing the *positive electricity*, go to the *negative pole*,* and those which have the *negative electricity*, go to the positive pole of the pile.

The *magnetic fluid* gives to a mineral called the loadstone (deutoxide of iron) the property of directing its two extremities, either to the north or south pole of the earth; of attracting by its northern extremity the southern extremity of another magnet, while it repels its northern extremity, or pole. It has recently been discovered that the magnetic needle changes its direction under the influence of the voltaic pile; that the conducting wires communicate magnetic properties to steel and iron wires. It has therefore been conjectured that magnetic attraction is but another modification of electricity. If these suggestions are rational, we may perhaps regard all the imponderable agents as the result of one grand agent.

PONDERABLE SUBSTANCES.

Class I. Supporters of Combustion.

All substances upon the globe except those already described under the head of imponderables, are known to possess weight; the specific gravity even of the lightest gases have been ascertained. After the discovery of oxygen, this gas was for some time considered as the only supporter of combustion, or the only substance which by uniting with others, could produce the phenomena of combustion. At present four other analogous substances are ranked with oxygen, viz. *chlorine*, *iodine*, *fluorine*, and *bromine*. When any one of these substances, existing in a binary compound, is submitted to the action of the voltaic pile, the supporter of combustion goes to the positive, and the combustible to the negative pole.

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* The two extremities of a voltaic battery, are called poles; this instrument was first called the *Galvanic* battery, from Galvani; afterwards, on being modified by Volta, it received its present name.

1. Oxygen unites with almost all substances, forming acid and oxide compounds; its name is derived from the Greek, and signifies to generate oxides; these and most of the acids being under the influence of this agent. Its properties are very numerous, since its combinations exist in most bodies in the three kingdoms of nature. It has been observed by a celebrated chemist, that "*oxygen may be considered as the central point around which chemistry revolves.*"

The phenomena of combustion bear an intimate relation to oxygen; so that the slightest union of this gas with another substance, although neither accompanied with sensible heat or light, is considered as a low degree of combustion. Stahl supposed that the fire exhibited in combustion was occasioned by the loss of an imaginary substance, which he termed *phlogiston*, or the principle of heat. Lavoisier proved the materiality of oxygen, by showing that it was absorbed by the burnt substance; but neither of them accounted for the heat produced at the moment of combustion, nor for the luminous appearance or flame which accompanied it.

By observing the usual circumstances of kindling a fire, we perceive that the temperature of the combustible body is first increased by a borrowed heat; now it is known that electricity is developed by an increase of heat, and that a union of the two electric fluids causes an elevation of temperature; thus, when the caloric is first added, the two electricities are brought forth, the negative from the oxygen and the positive from the combustible substance, and the union of these two electricities is supposed to produce the heat which attends combustion. When we assist combustion by the action of the bellows, we direct a current of air upon the combustible substance; the oxygen being impelled upon its surface, the fire becomes more intense; by repeating the action of the bellows we successively elevate the temperature, until the combination of the two electricities is sufficiently energetic to give rise to *flame*. The importance of oxygen as a supporter of combustion is manifested by various experiments; even metals inflame and burn spontaneously in this gas.

2. Chlorine was formerly called *oxymuriatic acid*, from its supposed constituents, *oxygen* and *muriatic acid*. It is at present, by the French and most English chemists, regarded as a simple substance; and muriatic acid is now called *hydro-chloric acid*, being as is supposed a combination of *hydrogen* and *chlorine*. Chlorine may be obtained by heating the pulverized per-oxide of manga-

nese with diluted hydro-chloric acid (muriatic acid); the hydrogen of the latter uniting with the oxygen furnished by the manganese, disengages its chlorine in the form of a yellowish green gas. Chlorine forms with oxygen several acids, as *chloric*, *oxygenated chloric*, &c. Its union with metals produces *chlorides*; these dissolved in water are *hydro-chlorates*.

3. Iodine, at the common temperature, exists in a solid form; its colour is a bluish gray; by heat it becomes a violet-coloured gas; it forms with oxygen *iodic acid*, and with hydrogen *hydriodic acid;* combined with sulphur, phosphorus, and metals, it forms *iodides*. Iodine is obtained from sea-weeds, mineral waters, minerals, and sponge.

4. Fluorine is considered as the base of fluoric acid, but as its actual existence has not been proved, it must be regarded in the light of an imaginary substance. Whether fluoric acid consists of oxygen united to the combustible base fluorine, or whether, as is supposed by some, this base is united to hydrogen, hence the term *hydro-fluoric*, instead of fluoric acid, seems not yet determined. This acid united to lime constitutes the *fluate of lime*, or the beautiful Derbyshire spar; with other bases it forms various *fluates*.

5. Bromine, which has been recently discovered and added to the list of simple substances, is obtained from sea-water and the ashes of the same marine plants that furnish iodine; it is a dark red liquid, so volatile as at the common temperature to throw off red vapours; with

oxygen it forms *bromic acid,* which uniting with various bases forms *bromates* and *bromides.*

COMBUSTIBLE SUBSTANCES.

Combustible substances are such as possess the property of uniting with oxygen and other supporters of combustion to form *oxides* and *acids;* they may be divided into the following classes:

Combustibles not metallic.
Metalloids, (resembling metals.)
Metals.

PONDERABLE SUBSTANCES.

Class 2. Combustibles not Metallic.

1. Hydrogen is a term derived from the Greek, signifying to produce water, because this liquid is formed by the combination of hydrogen with oxygen; in the language of chemistry water is the *protoxide of hydrogen,* (or hydrogen with one proportion of oxygen); when another proportion of oxygen is added, it becomes a *deutoxide of hydrogen,* or oxygenated water. Hydrogen combined with oxygen and carbon exists in all vegetable matter; by the addition of nitrogen we have the constituents of animal substances. Hydrogen forms acids known by the general name of *hydracids;* with chlorine it forms hydro-chloric, with iodine hydriodic acids, &c.; with sulphur, carbon, &c., it forms sulphuretted hydrogen or hydro-sulphuric acid, carburetted hydrogen, &c. It is highly combustible, and burns with much flame, furnishing by its union with carbon the gas used

in cities for lighting streets, shops, &c. On account of its being specifically lighter than atmospheric air, it is used for inflating balloons.

2. **Boron** combined with oxygen constitutes the base of *boracic acid;* it is by the decomposition of this acid that boron is obtained, it being never found pure in nature.

3. **Carbon**, when perfectly pure and crystallized, constitutes the diamond; it exists in charcoal with hydrogen, salts, and other products of combustion, and may be obtained from this combination. Many attempts have been made to crystallize carbon, in order to obtain diamonds, but hitherto none have been successful. With a certain proportion of oxygen, carbon forms *carbonic acid;* with a less proportion of oxygen, the oxide of carbon, or carbonic oxide gas. Carbon forms with hydrogen *carburetted hydrogen*, or gas light; with the alkalies it forms *carbonates*, as carbonate of lime, (marble,) carbonate of soda, &c. A peculiar property of carbon is that of absorbing putrid miasmata, or gases; a knowledge of this fact has given rise to some important applications to culinary operations, medicine, &c.

4. **Phosphorus** has received its name from two Greek words, signifying to bring light, this substance being always luminous in the air. With oxygen in different proportions it forms phosphoric acid, phosphorous acid, hypo-phosphorous acid, and oxide of phosphorus. With hydrogen it forms phosphuretted hydrogen, which inflames spontaneously in the air, producing the exhala-

tions, or *ignes fatui*, which appear about burying places and marshes. Bones and other animal substances when decomposing disengage oxygen, phosphorus, and hydrogen; these united form phosphuretted hydrogen, which being specifically lighter than the atmosphere ascends, and by its spontaneous combustion produces those luminous vapours which the superstitious and ignorant have referred to supernatural causes.

5. Sulphur united to oxygen forms *sulphuric* and *sulphurous acids*; these acids united to bases form *sulphates* and *sulphites*. With hydrogen sulphur forms *sulphuretted hydrogen*, and with the metals various *sulphurets*, as sulphuret of lead, &c.

6. Selenium is less known than any of the non-metallic combustibles; it forms with oxygen *selenic* and *selenious* acids and the oxide of selenium. Selenious acid forms with bases salts called *selenites*; selenic acid forms salts called *seleniates*.

7. Nitrogen* when first discovered was called *azote*, which signifies a depriver of life; this term appearing objectionable, as it is not a direct destroyer of life, that of nitrogen has been given from the circumstance of its being an essential ingredient in nitric acid. Nitrogen combines with oxygen in five different proportions, forming

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* In giving nitrogen a place among combustibles, it must be understood that it is not combustible in the common acceptation of the term, as it does not take fire upon being brought in contact with a burning substance, but it is combustible in the chemical sense of the term, since it unites with oxygen and other supporters of combustion.

Protoxide of Nitrogen,
Deutoxide of Nitrogen,
Hypo-Nitrous Acid,
Nitrous Acid,
Nitric Acid.

With hydrogen it forms *ammonia*, with carbon *cyanogen*, with chlorine and iodine a *chloride* and an *iodide*. The compound substance *cyanogen* (signifying by its name the *generator of blue*) is the base of *prussic acid*, (*hydrocyanic acid*,) which uniting to iron forms the colour called *prussian blue*.

PONDERABLE SUBSTANCES.

Class 3. *The Metalloids, or Earthy and Alkaline Combustibles.*

The termination *oids* is from the Greek and signifies like, or similar; thus the term metalloids denotes *like metals*. The substances comprehended in this class are in the strictest sense metals, but they differ from other metals in their strong affinity for oxygen, which renders it extremely difficult either to obtain or preserve them in a state of purity. It is but recently that they have been known to exist; potash, soda, lime, &c., were considered as pure alkalies, until Davy, by means of the voltaic pile, decomposed potash, and obtained a metal and oxygen; the metal he called *potassium;* thus it was discovered that potash is not an elementary substance, but an *oxide of potassium*. Reasoning from analogy, Davy and some of the French chemists were led to believe that soda, lime, and other alkaline substances, had metallic bases.

a series of brilliant and convincing experiments have now established this fact. Metals of this class seem naturally divided into two sections:

Section 1. *Earthy metals,* or metals which are the bases of earths; these are,

Silicon,	the metal of	Silex,
Zirconium,	,,	Zirconia,
Aluminum,	,,	Alumine,
Yttrium,	,,	Yttria,
Thorium,	,,	Thorina,
Glucinum,	,,	Glucina,
Magnesium,	,,	Magnesia.

Section 2. *Alkaline metals.*

Calcium,	the metal of	Lime,
Strontium,	,,	Strontian,
Barium,	,,	Barytes,
Sodium,	,,	Soda,
Potassium,	,,	Potash,
Lithium,	,,	Lithia.

Class 4. *Metals.*

This class contains substances which have in general less affinity for oxygen than the metalloids; many of them, such as silver and gold, cannot be easily oxidated; iron unites much more readily with oxygen, as may easily be perceived by exposing any iron vessel to the action of the atmosphere; in a short time it will be found *rusted,* according to the common term, but which chemically is said to be oxidated, the metal having combined with oxygen from the atmosphere. Any article of gold or silver is not thus acted upon by the atmosphere, nor even by water, which iron soon decomposes, by uniting with its oxygen.

We find then in examining the classification of elements or simple substances,

Imponderable bodies, ...	4
Supporters of combustion, ...	5
Combustibles not metallic, . . .	7
Metals, including metalloids, about .	40[*]

BINARY COMPOUNDS.

Binary compounds (from *bis*, two) are such as are formed by the union of two simple substances; these compounds are of three kinds; 1st, those which are *neither oxides* nor *acids*; 2d, oxides; and 3d, acids.

The binary compounds which possess neither the properties of acids or oxides are to be found in the union of the simple combustibles among their own class; as *carburetted hydrogen*, consisting of carbon and hydrogen; *cyanogen*, of carbon and nitrogen; *chloro-carbonous gas*, of chlorine and carbon. Sulphur with bases forms binary compounds, called *sulphurets*. *Steel* is a binary compound formed of carbon and iron. Oxygen in one, two, three, and even four proportions, forms a great variety of binary compounds; as with sulphur it forms in the highest proportion sulphuric acid, in a lower proportion it forms sulphurous acid, &c. The most important acids are mostly binary compounds.

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[*] For the arrangement of metals and their properties, see Dictionary, article *Metals*.

With the metals oxygen forms *oxides*, *protoxides*, &c. There are eight non-metallic oxides, viz.

The *Protoxide of Hydrogen*, or Water,
Peroxide of Hydrogen,
Oxide of Phosphorus,
Oxide of Carbon,
Oxide of Chlorine, or Euchlorine,
Protoxide of Nitrogen, or Exhilarating Gas.
Deutoxide of Nitrogen,
Oxide of Selenium.

The metallic oxides are very numerous; the peroxide of manganese is of great importance in chemistry, it being used for procuring chlorine, oxygen, &c. The deutoxide of iron possesses magnetical attraction, and is called the loadstone, or magnet. The deutoxide of lead is commonly known by the name of white lead. With the earthy and alkaline metals oxygen forms various oxides, as the oxide of silicon, or silex, the oxide of calcium, or lime, the oxide of sodium, or soda, the oxide of potassium, or potash, &c.

BINARY COMPOUNDS.

The Acids

Acids.

Combine with

Acids are distinguished by a sharp and pungent taste; they change vegetable blue colours to red, and combine with metallic oxides to form salts, or to alkaline oxides (as soda and potash) in order to neutralize or be neu-

Metalic oxides, Alkaline
oxides [illegible] Salts &

tralized by them. It was long believed that the acidifying power was confined to oxygen; hydrogen is now supposed to possess this property; thus the acids are now divided into *oxacids* and *hydracids*. The oxacids are numerous; some of the most important are,

Nitric Acid, composed of Nitrogen and Oxygen,
Sulphuric Acid, ,, Sulphur and Oxygen,
Carbonic Acid, ,, Carbon, Oxygen, &c.

There are four hydracids, viz. hydro-sulphuric, (usually called sulphuretted hydrogen,) hydriodic, hydro-chloric, and hydro-selenic.

QUARTERNARY COMPOUNDS.

Salts.

Salts are compounds of oxides with acids; as the acids are binary compounds, the salts are of course quarternary or quadruple combinations, they are of three kinds; 1st, *neutral*, presenting neither acid or alkaline properties; 2d, with *excess of oxide*; 3d, with *excess of acid.* The salts are divided into genera, each genus consists of the combination of one acid with various oxides, and is subdivided into three series, *neutral*, *super*, (over) and *sub*, (under). In all salts of the same genus, and at the same degree of saturation, the quantity of acid is to the quantity of oxide in a uniform proportion.

GENERA OF SALTS.

Borates. The most important species is the *sub-borate of soda*. It is found in some lakes.

CARBONATES. This genus is distinguished by being decomposed with effervescence, owing to the escape of carbonic acid. Among the most important species of this genus are *carbonate of lime*, consisting of chalk, limestone, &c.; *sub-carbonate of soda*, commonly called soda; *carbonate of ammonia*, produced by the decomposition of animal matter; *carbonate of iron*, a valuable mineral; *carbonate of copper*, of various colours, as blue, green, &c.; *carbonate of lead* is white lead; *sub-carbonate of potash* is the potash of commerce.

PHOSPHATES. In this genus is the *Phosphate of Lime*, which forms an important part of the bones of animals, and is used for the manufacture of phosphorus. *Phosphate of Cobalt* by calcining with alum forms a beautiful colour called Thenard's blue.

SULPHATES. The most common species which exist in nature are those of lime and barytes.

Sulphate of Lime is gypsum, or plaster of Paris.

Sulphate of Magnesia is Epsom salts.

Sulphate of Potash. Alum is a double sulphate of potash and alumine.

Sulphate of Soda is Glauber's salts.

Sulphate of Iron combined with nutgalls forms ink.

Sulphate of Copper (*Deuto*) is copperas, or blue vitriol.

NITRATES. But three species of this genus are found in nature. *Nitrate of Potash* is saltpetre; it is of important use in the manufacture of gunpowder. *Nitrate of Bismuth* is used in the manufacture of pearl-white. *Nitrate of Silver* is lunar caustic.

CHLORATES. More of this genus are found native. It contains the *Chlorates of Potash*, (oxymuriate of potash,) *Soda*, *Lime*, &c.

HYDRO-CHLORATES were formerly called *muriates*. When crystallized or dried, they lose the hydrogen of their acid, and become *chlorides*; these in their turn, when dissolved in water, form *hydro-chlorates*. *Hydro-Chlorate of Lime* (muriate of lime) is of use in medicine and in chemical experiments. *Hydro-Chlorate of Ammonia* is manufactured by the re-action of marine salt upon the sulphate of ammonia.

CHLORIDES.* There are many metallic chlorides, as chlorine has a strong affinity for metals. *Chloride of Calcium* is distinguished by having a great affinity for water. *Chloride of Sodium* is common salt; its properties are known in all civilized countries. *Chloride of Soda* has of late been found useful in removing offensive gases from the atmosphere, and preventing infection from sick persons or dead bodies. The chlorine is supposed to decompose the noxious exhalations by uniting with the elements of which they consist, particularly the hydrogen. *Chloride of Lime* is commonly called bleaching powder. *Chloride of Mercury* is subdivided into the *bi-chloride*, (deuto-chloride,) which is corrosive sublimate, and the *proto-chloride*, which is calomel. There are other important species in this genus; as the *Chlorides of Manganese, Iron, Silver*, &c.

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* The chlorides, although mentioned here, are not proper salts; they are analogous to oxides, iodides, and bromides.

Hydriodates. But one species of importance is known, viz. the *Hydriodate of Potash.*

Chromates. The most important species is the *Chromate of Lead,* which is a beautiful yellow.

There are other genera of salts, as the *nitrites, sulphites, phosphites,* &c., which are formed by combinations of nitrous, sulphurous, and phosphorous acids with bases; the properties of these, although in many respects differing from the salts formed with the higher acids, are not in general very dissimilar.

The organic kingdom furnishes an almost infinite variety of important compounds; *vegetable acids* are very numerous; the *acetic, tartaric, oxalic, malic, kinic,* &c., are all of use in medicine and in the arts. Among the *vegetable alkalies* are *morphia,* the narcotic principle of opium, *cinchonia* and *quinia,* extracts of the Peruvian bark, with many others. Oils, resins, wax, alcohol, ether, sugar, starch, tannin, lignin, and various colouring substances, are all products of the vegetable kingdom. Salts are formed by the union of the vegetable alkalies with acids, as the *sulphates of quinine, of morphine,* &c.

For the characters of nitrates, &c., see Dictionary.

Animal Chemistry presents a new set of compounds, as fibrin, gelatine, acids, and oils; it investigates the compounds of all animal matter, as bones, teeth, blood, and the various secretions; and traces all these to their final or ultimate elements, oxygen, hydrogen, carbon, and nitrogen.

THE END.

ERRATA.

Page 30, 15th line from top, insert *other* before ‘vegetable.’
·· 68, *12th line from top, for* 1825 read **1225.**
·‘ **187,** dele last sentence in page.
·· 188, 15th line from bottom, for *object* read *objectors*.

cR